Engineering News-Record

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Kreolite Lug Wood Blocks

"The Paving that's Saving"

Kreolite Lug Wood Block Floor on the Bridge over the Susquehanna between Nanticoke and West Nanticoke, Pa. Length of Bridge 191 ft; roadway 21⅓ feet in clear.

City Engineer Likes Lug Wood Block Floors

Berlin, Wis., Sept. 20, 1917.

Gentlemen:

The blocks are on the bridge and doing good service.

The Lug Block was new to me but will say that the saving in laying alone, more than offsets the additional cost.

I didn't have a man on the job that ever saw a block laid before. Had no trouble whatever and the floor is smoother and in better alignment than most of the pavements I have seen laid by old hands.

Yours very truly,

(Signed) C. G. WALKER,
City Engineer.

A Lug Block carries its own expansion joint, no bleeding, bulging nor buckling, and no excessive thrust against the fellow guard.

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A Last Word for James Peter Beck

IN THE portland cement industry Richard Hardy is known as the man who can not only generalize and summarize, grasp the bigness of problems and state them so all can understand, but also touch the heart strings, show forth the beauties of a man's life and point out its inspiration. Never did he any task better than the eulogy he delivered on James Peter Beck at the recent meeting of the Portland Cement Association. Because of its lofty sentiment and the interest it will have for Mr. Beck's many friends, it is printed in part in the news section of this issue. Would that all of us when we have passed beyond might have it said of us as Mr. Hardy says of Beck: "It has been good to have met Peter Beck on the way; good to have journeyed with him for an hour or two when life was still kind. We are all the better for having known him. . . . We shall often in the coming years turn to the page in our book of memories upon which his name is written." These sentiments will surely be re-echoed by everyone who knew Beck, who felt the force of his personality. It was indeed good to have met him on the way.

Clearing House Summary on Activated Sludge

FOR THREE YEARS the attention of all concerned with sewage treatment has turned with hope to the activated-sludge process. Like so many other innovations in sewage treatment, this one had its inception at the Lawrence Experiment Station, was seized upon and carried forward in England and later on taken up for intensive and extensive study in this country. The initial work at Lawrence and its elaboration by Dr. Gilbert J. Fowler and his followers in England should never be lost sight of by those who desire to give credit where credit is due. In America the activated-sludge process in its developmental stage has nowhere received more thorough study than at Milwaukee under T. C. Hatton and his able corps of assistants. In a large sense, Milwaukee has been a clearing house for activated-sludge data and opinion, for nearly everyone interested in the process has visited the Milwaukee testing station or at least has corresponded with Mr. Hatton. Among the services rendered by Mr. Hatton, not the least has been many papers he has written on activated sludge. The latest and ripest of these was presented before the Sanitary Section of the American Public Health Association at Washington on Oct. 18. It is so complete a review and summary that we take particular pleasure in presenting an extended abstract, containing substantially all its more essential features, beginning on page 840 of this issue. Lack of funds and space render uncertain the publication of American Public Health Association papers in its *Journal*. On this account, it is all the more important that a paper which will be read eagerly by hundreds of engineers and sanitarians all over the world be made immediately available.

The Twenty-Third Engineers—Supermen

FOR OBVIOUS reasons this journal's readers have an especial interest in the Twenty-third Engineers, the highway regiment now forming at Camp Meade. A month ago in need of recruits, with only 300 men enrolled, this journal was privileged to fire the first publicity gun in a recruiting drive, the ammunition being printers' ink. Last Saturday, three weeks after the first announcement was made in these pages, 1012 picked men swung into company front and passed in review before their commanding officer with an assurance of formation that only months of drill ordinarily give. The reason was not hard to find as one of the editors of the *Engineering News-Record* passed with the reviewing party along the long lines. The faces were those of strong men, men accustomed to direct others, men whose bearing betokened an ease that comes only with the habit of success, with accomplishment. The regimental records bore out the testimony of the faces—foremen, superintendents, mechanics, specialists in every branch of road making and its accessory arts—and all of them volunteers. In sum, the Twenty-third is gathering to it a superior type of men, the sort that give promise of making a great record on the lines of communication. And the letters of application pouring in daily are fully up to the standard already set. We have no hesitancy in saying that construction men who contemplate enlistment and have experience useful in the road-building art will not be disappointed in joining the Twenty-third.

Lack of Rolling Stock Forces Road-Material Embargo

THE ACTION of the Priority Board in issuing its second order, which forbids the transportation of road materials in open-top cars, brings home to the engineering profession in concrete terms the serious position of the country's transportation system in the matter of equipment. It is explained that, while the Priority Board recognizes the vital need for all the new road construction possible as a supplement to our overworked railroads, yet because there are not enough

coal cars in the country to supply the Navy, the merchant marine, our Allies, domestic munitions plants and public utilities with coal during the winter, to say nothing of the civil population of our own country, it is now necessary to eke out this supply by depleting the already inadequate supply of gondola cars to an extent which will shut off road construction during the winter. It is sincerely hoped by all parties to the promulgation of the order that it can be rescinded with the coming of warm weather at the very latest. There is no doubt that at the present moment we need the coal in the prosecution of the war far more urgently than we need the roads, and every highway official, engineer and contractor affected will cheerfully assist in enforcing the order and in using substitute transportation of some sort wherever feasible to keep important roadwork going. Neither is there any doubt that our rail transportation system is inadequate and in need of immediate financial help from the Government. If we would win the war, the railroads must not be allowed to rattle to pieces with antiquated equipment, run over properties which are depreciating because there is no money to keep them up. On the contrary, the facilities of the railroads must be increased to carry a traffic such as they have never borne before, and the property and equipment must be kept in first-class working order. If the Interstate Commerce Commission cannot afford the necessary relief at once, the Government must, by investing in their securities or otherwise, put its credit behind the railroads before another month has passed. The embargo on highway materials should spur every engineer whose opinion has weight with the Government to do his best to convince every official with whom he comes in contact that assistance to the railroads is prerequisite to the conduct of an offensive that will have military value.

Revival of River Traffic

THERE IS SUGGESTION of great future development in the step taken by the Government to revive freight-shipping on the upper Mississippi, noted on the news pages of this week's issue. If the barge line that will start next spring is a success, it will stimulate widespread public interest and enthusiasm, which are indispensable to the upbuilding of river and canal transportation.

Essentially a bulk-freight enterprise, the upper Mississippi project does not depend on the coöperation and support of many individual shippers. It can be maintained by a few large shippers and receivers, and does not depend vitally on general public interest. But conditions are otherwise for most other cases of waterway transportation, which, depending on package freight, must get their business from many individuals and must serve them adequately at collection and distribution points. It is this that makes so difficult the development of business on the almost completed New York State Barge Canal. Well-established public faith in the waterway service in all cases is, however, prerequisite to success; without it the business cannot be obtained nor proper terminal facilities planned and financed. Such public faith does not exist now. Success of the Mississippi barges would bring it.

If present indications are a gage of the true situation, the Mississippi enterprise will not have at the start the help of an active public interest. Such also is the situation in New York State. Thoroughly ingrained skepticism prevails over enthusiastic faith on the part of a few. This is but natural, in view of the long years of river idleness. The boats and barges of former times have gone to pieces and the old-time pilots have abandoned their calling. The public is waiting to be "shown." Success will convince it, even after the long history of river-traffic decay, the failure of a transportation project a year or two ago, and the indifferent success of an experimental barge trip between St. Louis and St. Paul, just made.

One important fact is clear even now, however: The railways stand ready to help the river enterprise throughout; as they have helped already the experimental trip. This new element in the situation must be reckoned as one of the great gains from our war emergency; it is another instance of the new coöperative spirit that is guiding all the country. Assured of railway support, river transportation has unhindered opportunity for development. It can succeed on its merits. It may prove its economy and capacity.

The problem is one of many complications, of which two only will be mentioned; one, the possible conflict between the demands of agriculture and of transportation, the other, the responsibilities of the municipalities in providing terminals.

The former issue was put squarely last month at St. Paul and for the time, at least, agriculture seems to have won over transportation. On the upper Mississippi the Federal Government maintains large storage reservoirs designed to control for navigation purposes the level of the river at St. Paul. Navigation there has been slight, so slight in fact that thousands of acres of land within the flowage lines of the reservoirs and connecting streams have been left dry, and neighboring farmers have taken advantage of the fertile ground to raise hay. This hay was growing nicely or was cut and stacked early this September when the Federal Government sent down the river the fleet of ore-laden barges which had previously delivered coal from the St. Louis district to the northern market. The barges met an extremely low stage of water, which could have been remedied by early filling of the control reservoirs and proper regulation, had not such control and regulation been forestalled by the importunities of the farmers whose hay crop would have been destroyed. Consequently, the fleet had to worry through an almost impassable stage of the river and the war-driven efforts of the Government to promote national efficiency by decreasing transportation costs were impeded by the war-driven efforts of the same Government to increase the food products of the nation. In regard to terminals the various municipal public-works men have an obvious duty. Immediate and adequate terminals must be built. Toward solving this essential part of the river transportation problem the Federal Government will contribute nothing—except possibly advice. If the river cities are, then, to realize on their geographical position they must overcome corporately their separate apathy and begin now to plan the connections and terminals without which all the government-owned barges in the world could not succeed as river carriers.

The Times Square Tangle

IT WILL BE INTERESTING to hear what the press of New York City has to say when the new dual subway system is put in operation, and those who use the New York Municipal Railway's new Broadway line discover what has been saddled on the public as an excuse for a station at Broadway and 42nd St., the main express stop of that line in Manhattan. As explained in *Engineering Record* for March 24, p. 452, this old layout was made long before experience demonstrated the density which traffic at such centers might reach, and was also made under the necessity of keeping the present subway across town at 42d St. in operation until the last moment—a necessity since removed.

Under this old plan, passengers can enter and leave the 500-ft. island express platforms only at the ends. These express platforms are more than two stories below the street. The exit stairs provided will also be used by incoming passengers—an inexcusable blunder of design in any circumstances—and are only 5 ft. wide between walls. Four of these stairs are to take care of half the total traffic at this station, which may well become the busiest of the entire dual system.

Although, after the publication of the article mentioned, and after agitation by interested associations in favor of changing this plan, it was announced that a new layout had been agreed upon which would greatly relieve the situation, it develops now that this new layout is not to be built. In fact, the structure as originally designed is already virtually completed and 30 ft. of backfill is being dumped on it at this moment.

There are commissioners and engineers in the pay of New York State on the force of the Public Service Commission for the First District whose plain duty it was to remedy this fault. They were fully cognizant of it, as is evidenced by their expressed intention to remedy it. They failed to do so, and, no matter what the circumstances, they must shoulder the blame.

Moreover, the circumstances are such as to reflect still further upon the conduct of these men. The changed plan, it will be remembered, included a mezzanine over the Broadway station from building line to building line. The contractor for the section including this station submitted a proposal to construct this mezzanine, including a price for cast-iron columns which the manufacturers warned was good for only one week. For more than a month, however, agents of the commission held up this plan, and finally attempted, on what was asserted to be too brief notice for action by the numerous interested estates, to make the owners of property adjoining this station contribute $60,000 toward the cost of the improvement. This in spite of the fact that the improvement was a necessary part of a city-wide rapid-transit system whose financing had already been provided for, and which is to be used by the entire public. Failing in this, the engineering force of the commission was directed to redesign this mezzanine, narrowing it between the curb lines and restoring certain ventilator structures (which have been rendered unnecessary by the installation of a mechanical system at this station), so that it will be physically impossible for the offending property owners ever to get any connection with the mezzanine. This redesign reduced the number of cast-iron columns by one-fourth, and made it necessary to place waterproofing in a narrow slot between the outside walls of the mezzanine and the ventilator structures mentioned, where the work would be very expensive. The contractor furnished a prompt estimate on this second proposal also, explaining to the commission that the waterproofing would cost more, and also explaining to the satisfaction of its engineering force that the price of cast-iron columns had increased greatly, and that the manufacturers would no longer furnish them at the first figure quoted. The entire matter, it is asserted, was agreed to, orally, and only the signing of the formal contract was necessary to initiate work on the change.

When this formal contract reached the office of the contracting firm it was noted that the price of the cast-iron columns had been reduced to the figure bid for the original change proposed, and that the price for waterproofing had been reduced to the price bid more than two years ago, when the general contract for the section was let. Thinking this a mistake, the contractor communicated with the commission before signing the document. He was informed, however, that the changes were not in error, having been made by one of the commissioners in person.

The amount involved is said to have been less than $1800. Although the contractor denies any intention of holding up the work on account of it, the entire handling of the affair is said to have been so offensive that it soon became evident to the contractor and his legal advisers that there was no use in pursuing the subject further while the commission looked at it in that light. The commission was notified that, as it would not adjust these items or even discuss the matter further, the contractor would not sign the agreement.

Of course, it is always possible for the engineers concerned to advance the argument that the contractor, by selfishly grasping after a paltry $1800, held up this needed improvement in the new transit system. It is also possible to assert, as has been done on the part of the commission, that this and other changes were proposed by the contracting firm to recoup heavy losses faced on the original contract because of changed conditions since it was let. Even if proved, this charge is not of a criminal nature. On private projects it is considered poor financial policy for an owner to compel the execution of a contract under such conditions.

Furthermore, neither of these arguments would hold water even if the contracting firm concerned were seven times the essence of greed. It is hardly the business of the contracting firm under circumstances such as those related to see that the design of the structure it builds is suited to the needs of the owner. It is most emphatically the duty of the Public Service Commission and of its engineering staff to see to this point, and no action by third parties can possibly relieve them of this obligation to New York City.

The damage done to the city, while serious, is temporary, and of a pecuniary nature. It will not be long after the line is in operation before public protest will force the city to dig up this station and reconstruct it in a proper manner—at greatly increased expense. The damage done to the standing of the engineer is not quite so tangible, but its effects are liable to persist for a longer time.

Tests Show Advantages of Laying Brick Directly on Concrete Base

Comprehensive Research Completed at the University of Illinois Justifies the Assumption That the Strength of Such a Slab Is the Same as That of an Equal Thickness of Concrete

By C. C. Wiley
Instructor in Highway Engineering, University of Illinois

AFTER A SHORT series of tests on the monolithic type of brick pavement construction, which tests were described in *Engineering Record*, Jan. 15, 1916, p. 86, the University of Illinois undertook a longer series of tests with the intent of confirming more fully the points brought out by the preliminary tests and of furnishing, if possible, reliable data upon which the design of a brick pavement could be based. The test series laid out by the Department of Highway Engineering was carried through by H. H. Edwards and R. P. Brown, highway engineering students of

ALL SPECIMENS WERE 23 x 45 IN., BEING FABRICATED IN SPECIAL FORM

the class of 1917, and has demonstrated rather conclusively that the monolithic type which dispenses with the dry mortar beds is superior in many ways, and that the strengths developed in cross-breaking are at least equal to those exhibited by a concrete slab of the same thickness and having the same composition as the base of such a composite slab.

The present and more extended series comprised 66 slabs of four general types, as follows:

1. Plain concrete slabs indented to represent ordinary concrete roads, and the concrete base used in other kinds of pavement.

2. Monolithic brick slabs of the type first constructed in Paris, Ill., and adopted by the Illinois State Highway Department. This type is referred to in this paper as the "dry-layer" type, since a thin layer of mortar is used to smooth the surface of the concrete.

3. Monolithic brick slabs of the kind used on the bond-issue roads of Vermilion County, Illinois, in which the bricks are laid directly on the green concrete. This type called here the "direct-contact" type, was described in *Engineering Record*, Sept. 30, 1916, p. 400.

4. Monolithic slabs consisting of grouted brick only.

Each of these four types is represented by several groups which differ in details. Each group consists of three specimens.

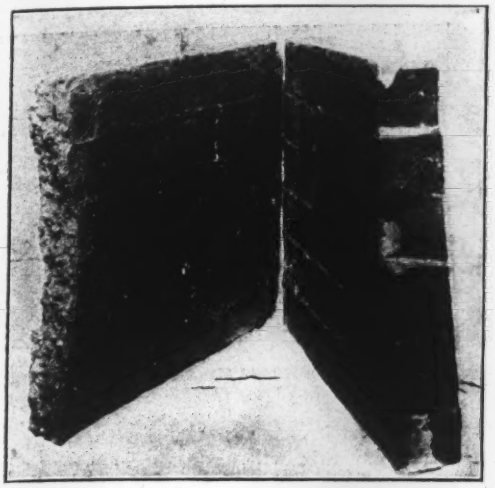
The aggregates used in the concrete were washed gravel and sand of well-known excellence obtained from glacial deposits along the Wabash River near Covington, Ind. The gravel was well graded from 1 in. down to ¼ in., except for the slabs with very thin bases, where a roofing gravel ranging from ½ to ¼ in. was used. The sand for the concrete was well graded from ¼ in. down, while that used in the dry mix would pass a ⅛ in. screen.

At first the same sand as that employed in the dry mix was used in the grout filler, but later this was replaced by a fine, hard, silicious sand from Lincoln, Ill., all of which would pass a $\frac{1}{16}$ in. mesh. A standard brand of portland cement was used and a quantity sufficient for the entire series was purchased at one time on the open market.

The bricks were "Danville Block," furnished through the courtesy of Harvey C. Adams, president of the Danville Brick Co., Danville, Ill. Wire-cut-lug bricks were used in virtually all slabs. A few semi-repressed blocks having a bar-shaped spacing lug entirely across one face, and a few 2-in. plain wire-cut bricks were used in some slabs.

Every precaution was taken to maintain strict uniformity in all test conditions. Tests were made of all materials, to insure uniform quality. The materials were stored indoors so as to be always air-dry and in addition the aggregates were oven-dried at a low temperature shortly before using, to insure a uniform water content. The materials for each batch of concrete were measured separately and every operation of mixing the concrete, molding and grouting the slabs, and then

SPECIAL TESTING RIG APPLIED LOAD AT THIRD-POINTS



MORTAR ADHERES TO BASE IN DRY-LAYER TYPE, SHOWING LOW BOND TO BRICK

curing and testing them, was strictly standardized. The results are therefore believed to be comparable and free from undue variations.

The concrete was proportioned by volume—a sack of cement being considered as 1 cu.ft.—and was mixed in a small, power-driven, batch mixer. In the first tests the grout was mixed by hand, but later it was mixed in the same machine.

The slabs measured 23 x 45 in., as these dimensions accommodate six courses of five bricks each. Wooden forms were used, and the slabs were fabricated on a concrete floor, using building paper as a separator. After the concrete was deposited in the form it was struck off to the desired depth by means of a template. If the slab were of the "dry-layer" type the dry mix was spread and smoothed off with a second template so set as to form a layer of the dry mix about $\frac{3}{16}$ in. in thickness. If it were of the "direct-contact" type the same template was used for cutting the concrete and for tamping the surface to a slightly puddled condition to receive the brick. In either case, the bricks were laid and tamped lightly to an even surface and then sprinkled and grouted, a rubber-edged squeegee being used to finish the surface.

When two days old the slabs were covered with about 2 in. of sand, which was kept moist until the 26th day, when it was removed and the slabs were transported to the testing laboratory, where they were permitted to dry in air until tested.

All slabs were broken at the age of 28 days in an Olsen testing machine of 200,000 lb. capacity. Because the slabs were too wide to go between the screws of the machine, they were placed on the table extension and the load was transferred from the head of the machine through a needle beam, as is shown in the illustration. The load was transmitted from the needle beam to the slabs through a loading rig of small I-beams so spaced as to concentrate the load equally on the third-points of the span. The slabs were supported on bearing plates resting on rollers spaced 42 in. between centers. Plaster-paris was used to bed all bearing plates on the slabs.

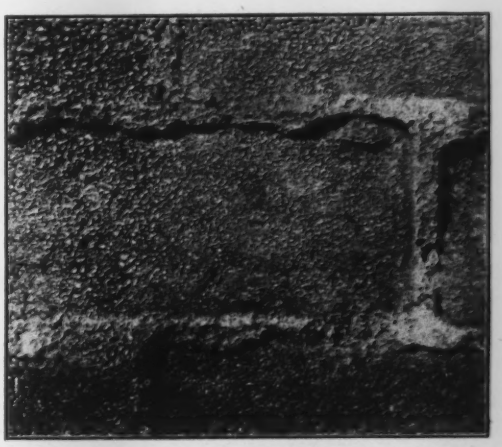
The fractured specimens were placed out of doors with the broken edges uppermost and exposed directly to the weather, for the purpose of observing the effect of the elements. Some of the slabs have been exposed for more than a year, but all of them have not been outside a sufficient time to give reliable indications.

Since the slabs were broken on their smaller dimension, it follows that those slabs having longitudinal courses were broken across the courses, corresponding to a longitudinal crack in the pavement; while those with transverse courses were broken along a grouted joint, corresponding to a transverse crack.

Comparison of the results given in the accompanying tabulation will show that when the concrete side of the slab is in tension the direction of the brick courses has little effect on the strength, and that the modulous of rupture is approximately that of plain concrete of the same quality. This is true when the concrete forms roughly one-half of the thickness of the slab. With the very thin bases, the brick makes up a sufficient part of the total slab to govern its behavior.

When the brick are in tension there is a marked difference in strength with the direction of the courses of brick, as would be expected. Here the slabs with longitudinal courses show high strength, in most instances greater than that of 1:2:3 concrete. This is doubtless due to the fact that the bricks lap in such a way that a shearing stress is set up between the bricks and the grout, and the bond in this direction is sufficient to develop high beam strength. The slabs with transverse joints are very much weaker, since in this case the stress is direct tension on the bond between the brick and the grout. The beams with diagonal courses show a strength intermediate between these two.

At first thought, it would appear that with this wide difference in strength in the two directions the pavement would fail when subjected to the load that would suffice to set up the necessary stress in the weakest plane. Such, however, is not the case. With a load concentrated at a given point the tendency to deflect is the same in all directions, and as fracture cannot occur until a certain amount of deflection takes place, it follows that the slab will not fail along this weakest section sooner than elsewhere, unless the con-



SAND GRAINS OF DRY-LAYER MORTAR NOT COVERED WITH CEMENT—MANY GRAINS DISLODGED

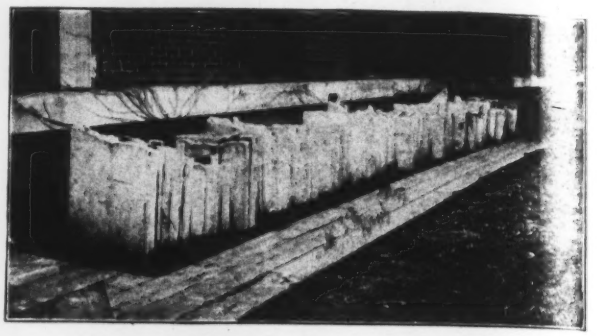
ditions of loading are such that the greatest tendency to deflect is along this plane. As the only condition of loading which would cause such deflection is that of a simple beam, and as such a condition is highly improbable in a pavement, it follows that the weakest section does not govern of necessity the strength of the road.

Little difference in strength is noted between the "dry-layer" type and the "direct-contact" type of construction, and what difference exists is probably due to a difference in the grout. The "dry-layer" slabs used a grout of ¼-in. sand, which a few tensile tests showed to yield a stronger grout than the $\frac{1}{16}$-in. sand used in the "direct-contact" specimens. It is worth noting, however, that the grout of ¼-in. sand was decidedly more difficult to mix properly and showed more tendency to segregate than did the other—a point worth considering in actual construction.

In the "dry-layer" type of construction the bricks show the greater tendency to separate from the concrete. The materials in a dry mix are never associated as intimately as those in a wet mix, and consequently the cement does not come into as thorough contact with either the sand grains or the brick. The "dry-layer" is, therefore, weaker than the underlying concrete, and

MODULI OF RUPTURE OF SLABS

Description of Slab	Group	Slab Nos.	Thickness, Inches: Concrete	Brick	Total	Material in Tension	Averages: Total Load, Lb.	Modulus of Rupture, Lb. per Sq. In.
1:2:3—Plain concrete	A	A7, A8, A9	6	0	6	Concrete	9,512	480
	B	A10, A11, A12	7	0	7	Concrete	12,815	478
1:3:5—Plain concrete	C	B37, B38, B39	7	0	7	Concrete	11,735	437
"Dry-Layer" Type 1:3:5 — Concrete base, 1:3 — Dry layer, 1:1—Grout, ¼ in. sand. Longitudinal courses	D	A13, A15, A19	2	4	6	Concrete	9,888	502
	E	A14, A17, A18	2	4	6	Brick	10,258	523
	F	A1, A2, A6	3	4	7	Brick	12,505	466
	G	A3, A4, A5	3	4	7	Concrete	14,293	532
Same, except courses at 45° to axis of slab	H	A20, A22, A23	3	4	7	Concrete	11,485	428
	I	A21, A24, A25	3	4	7	Brick	7,052	263
Same, except transverse courses	K	A30, A36, A37	3	4	7	Concrete	12,207	455
	L	A32, A33, A34	3	4	7	Brick	4,357	163
1:3—Concrete base, dry mix, using ¼ in. sand. Courses at 45°	M	A26, A27, A28	1	4	5	Concrete	5,162	377
"Direct-Contact" type. 1:2½:4—concrete base, using ¾ in. roofing gravel. 1:1—Grout, using $\frac{1}{16}$ in. sand. Longitudinal courses	N	B1, B2, B3	1	4	5	Concrete	7,400	540
	O	B4, B5, B6	1	4	5	Brick	7,478	546
"Direct-Contact" type. 1:3:5—Concrete base. 1:1—Grout, using $\frac{1}{16}$ in. sand. Brick laid 1½ hr. after placing concrete. Longitudinal courses	P	B28, B29, B31	3	4	7	Concrete	12,820	478
	Q	B30, B32, B33	3	4	7	Brick	11,730	437
Same as above, except brick laid 5 hr. after placing concrete	R	B34, B35, B36	3	4	7	Concrete	12,287	470
Grouted brick. No base. 1:1—Grout, using $\frac{1}{16}$ in. sand. Longitudinal courses	S	B7, B8, B9	0	4	4	Brick	4,988	569
Same, except transverse courses	T	B10, B11, B12	0	4	4	Brick	1,323	151
Same, except joints broken ½ brick instead of ½	U	B22, B23, B24	0	4	4	Brick	5,122	585
Same, except semi-repressed brick with straight bar lug used	V	B25, B26, B27	0	4	4	Brick	4,732	540



ALL SPECIMENS WERE EXPOSED TO WEATHER AFTER TEST

the bond to the brick is not great. Further, any water falling on the dry mix will wash the cement from the exposed grains and frequently the wind blows so much of it away that the bricks are actually in contact with a layer of sand instead of mortar. In addition, it is not improbable that moisture collects in the porous dry layer and may later cause separation by freezing.

On the other hand, the "direct-contact" type furnishes a bed of thoroughly mixed wet mortar favorable to a close contact of brick and cement. Some incomplete tests indicate that the direct tensile bond of the brick to the concrete is several times greater in the "direct-contact" type than in the "dry-layer" type. Incidentally, none of the "direct-contact" slabs exposed to the weather has shown signs of separating, while several of the "dry-layer" type have given such signs.

Tests of slabs composed of brick only show clearly that the grouted slab possesses considerable strength of its own—a fact apparently overlooked in the design of the sand-cushion type of pavement. Evidently, the base was expected to furnish the strength and the brick to serve only as a wearing surface. But after all, the brick portion is a rigid slab on a more or less compressible foundation, and it is necessary for it to carry the load first.

The monolithic type of construction combines the strength of the brick slab with that of the concrete base in such a manner as to develop the maximum in both, and these tests show that such a compound slab is fully equal in strength to a concrete road slab of the same thickness. It appears therefore that in the monolithic brick road the brick and the concrete should not be considered as separate units of a pavement, but rather as integral parts of a single structure. In other words, a monolithic brick slab 7 in. thick should not be viewed as 4 in. of brick on 3 in. of concrete, but should be treated as a 7-in. concrete slab. The bricks are essentially aggregate of high wear-resisting qualities. This may be expressed in another way—if a 7-in. slab of concrete is sufficient to carry the load, so is a 7-in. monolithic brick slab---with the added factor of high resistance to the wear and tear of traffic. With this type of construction it seems therefore entirely logical to reduce the total thickness of the slab, either by reducing the thickness of the base or by using thinner bricks, provided a sufficient gross thickness is retained to furnish strength enough to carry the probable loads, and this necessary gross thickness can be determined on the same basis as the thickness of a concrete road.

Unsanding Two Deep Wells

Special Expedients Necessary to Remedy Faults That Were Introduced by Drilling Without Engineering Supervision

By W. C. Hammatt
Consulting Engineer, San Francisco

IT IS a frequent occurrence that deep wells, bored by well-drillers without engineering supervision, fail to give the expected quantity of water; or if the expected quantity of water is produced, it is frequently accompanied by so much sand as to make impracticable the maintenance of the ordinary type of deep well pump. Recently the conditions in two such wells were referred to the writer to diagnose and put in operating condition.

The first of these wells is shown in Fig. 1, accompanied by the log as furnished by the well-borer. Since this well was bored without engineering supervision, it was impossible to identify the materials corresponding to the nomenclature furnished by the well-borer and, therefore, impossible to determine from just which stratum appeared the sand which was being pumped.

This well is 12 in. in diameter and 243½ ft. in depth —the casing being perforated for 100 ft. from the bottom. A test of this well with an airlift showed a capacity of 116 gal per min. over a period of three days, with a drop of the water level of less than 40 ft. below its static condition. A pump was installed with a capacity of 100 gal. per minute, but very soon the pump began handling such a quantity of sand as to make it impossible to operate for more than two or three days without changing leathers. This sand was yellow in color and 80% passed a 40-mesh sieve. Since no samples were taken of the various strata during the boring of the well, there was no certainty that the sand entering the well during operation came from any particular stratum.

Presumably the greater quantity of the water came from the blue and gray water sand near the bottom of well, with perhaps a fair quantity from the gravel stratum between the 171-ft. level and the 180-ft. level. Since there was some doubt, however, in regard to the well-borer's method of taking measurements, the writer did not consider it safe to attempt to make use of the upper stratum, but decided to case out practically all water except that from the blue and gray water sand. The method of doing this was as follows:

An 8-in. inner casing was installed and centered with the outer casing by means of metal straps. The bottom 18 ft. were perforated with slits ⅛ in. wide, providing an aggregate area of about 200 sq.in. The 8 in. casing was extended upward for a distance of 100 ft. above the bottom of the well, where a taper section increased the diameter to 9 in.

The bottom 18 ft. between the two lines of casing was then filled with gravel accurately screened by hand to pass through a 2-mesh sieve and be retained by a 4-mesh sieve. The next 2 ft. were filled with gravel accurately screened to pass through a 4-mesh sieve and be retained by a 10-mesh sieve. The next 2 ft. were filled with hand-screened gravel, 10- to 20-mesh; the next 2 ft., 20- to 40-mesh; and the next 2 ft., 40- to 80-mesh. From this point upward the whole space between the two casings was filled with ordinary sand running from about 10-mesh to 80-mesh, but not accurately segregated.

This segregation makes it impossible for sand of one size to pass through the sand of the next larger size below. Thus the advantage of filtration through the smallest size is obtained without danger of pulling any

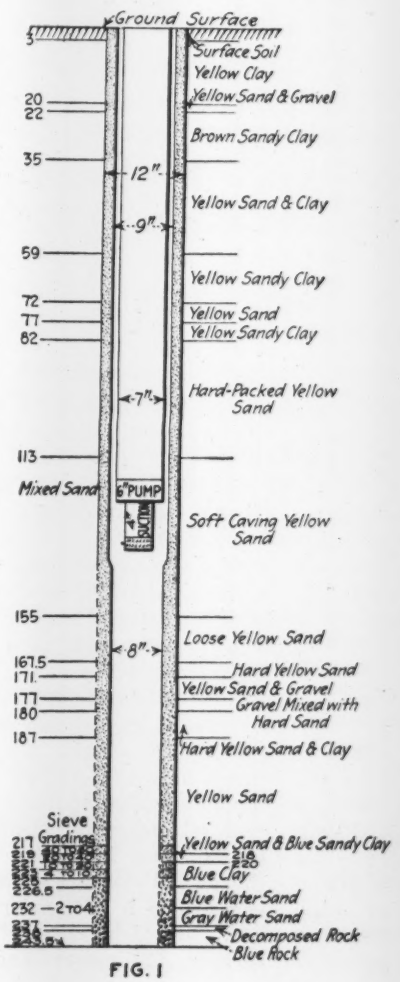


FIG. 1

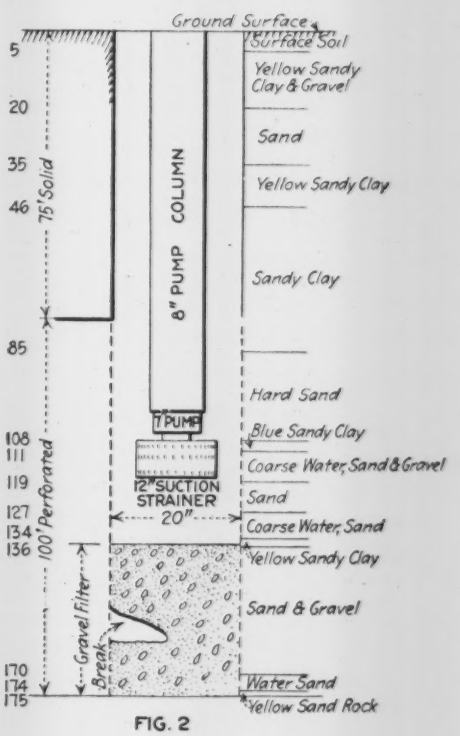


FIG. 2

FIG. 1. GRADED GRAVEL AND SAND PREVENTED FINE SAND FROM CLOGGING WELL

FIG. 2. BREAK IN CASING REPAIRED WITH GRAVEL FILLING

of it through the perforations. While this method does not actually shut off the water from the yellow sand, it requires it to be filtered through the sand between two casings before it comes through the perforations at the bottom of the inner casing, and keeps any of the yellow sand from being drawn into the bore of the well.

On the completion of this installation the pump was overhauled and again put in commission. It was found that the capacity had diminished to about 83 gal. per min., though the difference in capacity probably was due only partly to the partial shutting off of the water derived from the yellow sand, since the test was made at a season of the year when the wells were delivering their minimum quantity. The pump has now been in operation for some time with a uniform discharge and virtually no sand.

Light Steel Casing

The second well was bored in 1908 at a time when materials were hard to obtain, and it was therefore cased with very light, black steel casing, perforated with slots about $\frac{1}{16}$ in. in width for the lower 100 ft. The well was 20 in. in diameter and 175 ft. deep, the log being as shown in Fig. 2.

The winter had been one of extreme drought, and with the beginning of the summer season a larger quantity of water than usual was needed. The wells were all cleaned for the purpose of increasing their supply. Shortly after the pump in this particular well was reinstalled, it stalled suddenly. On pulling the pump column it was found to be filled for a height of 45 ft. with sand and gravel. The well itself also was found to be filled for over 20 ft. with sand mixed with gravel, some pieces being as much as 4 in. in diameter. It was therefore clear that the casing had caved, and an attempt to clean the well showed the cave-in to be about 18 ft. above the bottom, where the casing had bulged nearly to the center of the well. While there was a possibility of forcing the casing back to its original section by means of a specially designed bulger, this procedure was considered to be so costly and precarious as not to warrant the attempt. A new well to replace the old would not only be expensive, but the boring would require time. Repairs to the existing well were carried out in the following manner:

The sand and gravel were completely removed from the bore of the well by means of a sand pump small enough to pass the bulge in the casing. The bore of the well was then filled to a depth of 40 ft. from the bottom with coarse gravel which would pass through a 1-in. mesh and be rejected by a ½-mesh. This is well above the stratum where the break occurred.

Gravel Prevents Further Caving

This gravel was intended merely to hold the weight of the caved material and prevent it from entering the bore of the well or forcing in the casing any further. The stratum from which the water is produced consists of very coarse gravel with some fine sand, and the drawing out of this sand from the gravel, over a period of years, probably caused the ultimate movement of the remaining gravel. It is probable that very little more sand will be drawn from this stratum, as the period of pumping has been so great that the sand has probably all been removed for some little distance from the well. On this probability reliance was placed. If much more sand were to be drawn from this stratum, it would ultimately fill the voids in the gravel in the bore of the well and would cut down the production to a considerable extent. This will take a long time and meanwhile the well can be kept in use, thus avoiding the expense of boring a new one.

Since this well was restored it has produced 67 gal. per min. against 42 gal. per min. which it was producing prior to the cave. It is thus evident that the cave which broke the casing opened up the water stratum and somewhat facilitated the production of water therefrom.

Professional Questions

Engineers are urged to send to the Editor comment on cases presented in this section or statements of their own experiences in matters of professional ethics.

Communications must be signed, but names will be withheld from publication, if the writer so desires.

Employees with Better Jobs in Sight

Referring to the editorial in *Engineering News-Record* of Aug. 30, p. 386, "Professional Questions Call for Study," two highway engineers have written to this journal urging discussion of the practice of some employers (1) declining to consent to their employees being offered more remunerative positions by others, when their consent is asked in advance; or (2) declining to recommend employees who have been approached by prospective employers who offer greater remuneration.

Charges for Professional Services

An engineer makes the following inquiries as to charges for professional services:

"I will greatly appreciate an opinion on the matter of professional charges from both the architect's and engineer's point of view in the following cases:

(1) A new corporation is to build approximately $67,000 worth of new mill buildings for automobile construction and wants me to furnish a complete set of plans, all details, have charge of all contracts, furnish complete supervision and hire men for inspection during the construction. Is 6% of the above price all right?

"(2) A corporation engages an engineer to make preliminary studies for railroad trestles, coaling stations, industrial railways, steam railroad connections, concrete bridge abutments, steel plate girders, preparation of contracts, right-of-way maps, full charge of construction, hiring of inspectors, and to assume full charge of the entire work. What is a fair price for this engineering? If the work were divided into three parts, what should be charged for (1) the preliminary conference; (2) surveys and maps, plans of bridges, cross-

section and final estimate; (3) entire engineering services?"

What is the opinion of *Engineering News-Record* readers as to the amounts of the fees which should be charged in the cases cited?

Questionable Practices in Engineering Work

THE LETTER by S. Whinery in *Engineering News-Record* of Oct. 4, p. 657, raises a question about which more should be written, according to D. R. Shearer, of Johnson City, Tenn., who submits the following comment: Of course, the average engineer has a general idea of the ethics of his profession, but this idea is not always clearly defined in his mind. To follow any line of conduct it is necessary to have a very definite knowledge of the tenets embodied and to feel that the line of demarcation between the good and the evil of a certain creed is plainly evident to all concerned.

It seems to the writer that the engineering societies should give greater publicity to their respective codes of ethics, and that the engineering journals should publish such a code as is applicable generally to the profession. If this should be done and you should adhere to your purpose of commenting upon special cases as they arise, it seems that engineers acting in an unprofessional manner necessarily would absorb gradually so much knowledge of the questions involved that it would act as a deterrent of many practices now in vogue among certain classes of the profession.

Engineering is a business as well as a profession, but a true code of ethics is as applicable to a business as to any profession, so that those engaged in the essential branches of business connected with engineering are in no sense immune from an application of ethics to their own work.

There is one questionable practice which seems to be growing upon the profession in recent years and about which little is heard in the journals and societies. That is, the selling on commission of certain machinery or equipment by engineers who are supposed to represent their clients in an impartial and unprejudiced manner. Of course, there are many sales engineers who often are called in as consultants, but in such cases the clients know what they are doing. The trouble comes from the engineer engaged in general practice who has surreptitiously certain agreements with manufacturers and of course recommends the products of those manufacturers without carefully weighing the advantages of equipment made by other manufacturers of similar lines.

Another practice which may not be unethical, strictly speaking, is often evidenced among engineers to their discredit, and that is the recommendation of equipment made by a certain manufacturer simply because the engineer was trained in the shops of that firm or has a better knowledge of that line. It is true that there is great difficulty in taking an absolutely unprejudiced view of any question, but that view should be the aim of every engineer engaged in general practice. It is only by looking at every question from all sides that the engineer can render the greatest service possible to his client.

Copper Town Outgrows Its Water and Sewage Systems

ENORMOUS growth in the output of the Globe-Miami copper mining district in Arizona has put an added strain on the water-works system, and made the antiquated cess pools and the private sewers to the nearest ravine a menace to the health of Globe, a city of 10,000. The payroll of the district is $1,500,000 per month, and 25,000,000 lb. of copper is produced.

Labor and I. W. W. troubles have prevented a bond issue of $500,000 from being put up for vote until this fall, although a report by the Benham Engineering Co. on the questions has been in the hands of the officials since June. From this report we learn:

Globe secures its water from a deep well and a system of shafts and galleries or tunnels about ½ mile from the southern limits of the city. The latter is a surface supply, 54, 65 and 165 ft. below ground level. In 1914 the surface supply became inadequate and a well was sunk from the bottom of the lowest shaft 910 ft. below the surface. A turbine pump of 700-gal. per minute capacity is located 100 ft. below the surface of the ground. Since its installation the well has furnished the greater portion of the supply and continuous pumping at full capacity has never lowered the surface more than 5 ft. The engineers felt that the city should not expend, until need arose, a vast amount of money in developing a more costly surface system by impounding winter and flood flow. From the top of the existing well the penetration of the Gila conglomerate, through a series of water bearing formations, indicates that a second well of similar construction will furnish all the water needed for many years. The Gila conglomerate is essentially a valley deposit at least 700 ft. deep over the Pinal Creek area surrounding Globe and extending south 4 miles and west 5 miles, running northwest toward Miami, where it narrows considerably. The formation is a firm but not hard conglomerate, varying from fine sand to boulders 8 ft. in diameter. High timbered mountains, snow covered in winter, are the source of the supply.

The daily water consumption in Globe averages 25 gal. per capita, and the 1840 water accounts, 1600 of which are metered, each yield $24.50 per year. Costs of pumping per 1000 gal., excluding depreciation, for 1913 to 1916 inclusive, have been as follows: 27.5 cents, 38.6 cents, 46.8 cents and 38.8 cents. The abnormally low consumption is due to the small amount of waste and to the fact that no industries are supplied. The engineers estimate that with a new sewer system installed the increase will be but 50 per cent, because the residences are now mostly connected with cess pools or private drains.

Wrought or galvanized iron pipe only has been used for mains, and in the engineer's opinion its life does not exceed 10 years, the present system requiring con stant repairs and renewals.

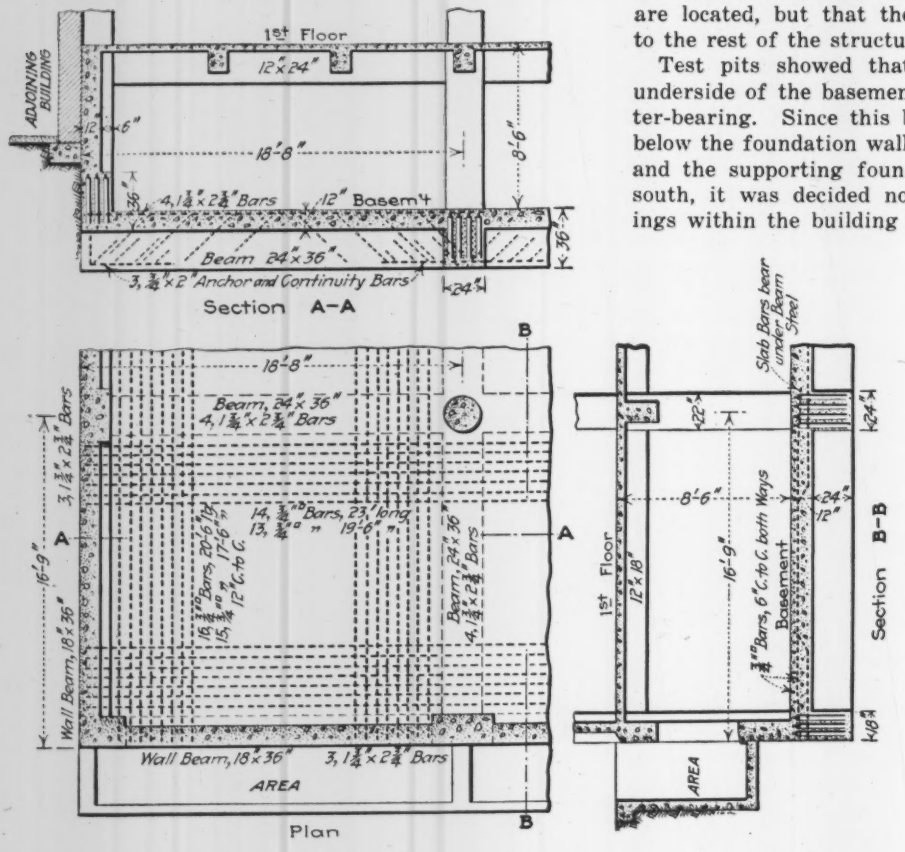
The sewer system presents no difficulties, as the grades are heavy and comparatively small pipes may be used for mains and to connect with the two Imhoff tanks below the city discharging into Pinal Creek.

Assisting the Benham Engineering Co. in making the investigation were R. A. Smith, city engineer, and George Cook, water superintendent.

Floating Foundations Carry Two Concrete Buildings

Factories in Chicago and Camden Have Inverted Floor System to Distribute Loads Over Soft Ground

THE USE of a mat foundation for spreading the weight of a heavily loaded concrete building over a soft foundation is well illustrated in two widely separated structures recently completed. One is for the Farr & Bailey Manufacturing Co. in Camden, N. J., the other for the Felt & Tarrant Manufacturing Co. in Chicago. In both buildings the foundation is an inverted reinforced-concrete beam-and-slab system distributing the concentrations of the column loads uniformly over the ground surface.



DETAIL OF CORNER OF CAMDEN BUILDING, SHOWING FLOATING FOUNDATION

It was intended originally that the Camden building should occupy only the area of the two bays of the north side of the building (which is on the left-hand in the accompanying view) and should be connected by a bridge at the fifth floor level with the large building at the south side. This first decision was made because in line with the present third and fourth bays there was a street which was a part of the driveway system of the plant, and also because a one-story building occupied the space on the south bay, and housed six sets of steam coils and blowers—equipment needed for one of the processes in the manufacture of linoleums carried on in the building. After more thorough consideration, it was decided to cover the entire area with a building five stories high, using the first floor of the south bay to house the blower equipment, and the next adjoining bay for the driveway.

Because the blower machinery rested on foundations built on the ground, and because it was impossible to shut down this equipment, it was not possible to permit any part of the foundations to occupy any of this area, so it was decided that the new building should not have a basement under the southern bay where the blowers are located, but that the basement should be limited to the rest of the structure.

Test pits showed that the supporting soil at the underside of the basement floor was very soft and water-bearing. Since this basement extended very much below the foundation walls of the building on the north and the supporting foundation of the blowers on the south, it was decided not to construct separate footings within the building lines, but to design the basement floor as a supporting floor, with girders extending both ways from column to column, and projecting below the basement floor as detailed in one drawing shown herewith. This entire reinforced-concrete floor was designed to distribute the weight from the columns by the cross-girders and the slab over the entire area, equalizing the weight as much as possible. Therefore the reinforcing steel in both the girders and the slab had to be located near the top of the concrete, reversing the ordinary method of reinforcing a floor when the load is superimposed.

Later, on account of necessary changes, some of the girders were incorporated in the exterior walls above the basement floor slab. This was preferred to extending them below as in the case of the intermediate girders.

Because of the location of the blower machinery in the south bay, it was impossible to construct column footings or columns against the building on the south; therefore the south bay of the new building had to be carried on the brick wall of the old building, not a desirable but a necessary solution of the difficulty. Nevertheless, no cracks have appeared in either building from unequal settlement.

Plans for the structure were made by Layton F. Smith, then an engineer of Baltimore, Md., but now an officer in the United States Naval Reserve. The contractor was the Harrison C. Ray Co., of Philadelphia.

The Chicago building is a five story and basement warehouse and factory which is to be used largely for the storage of steel plates and bars. The floors are sub-

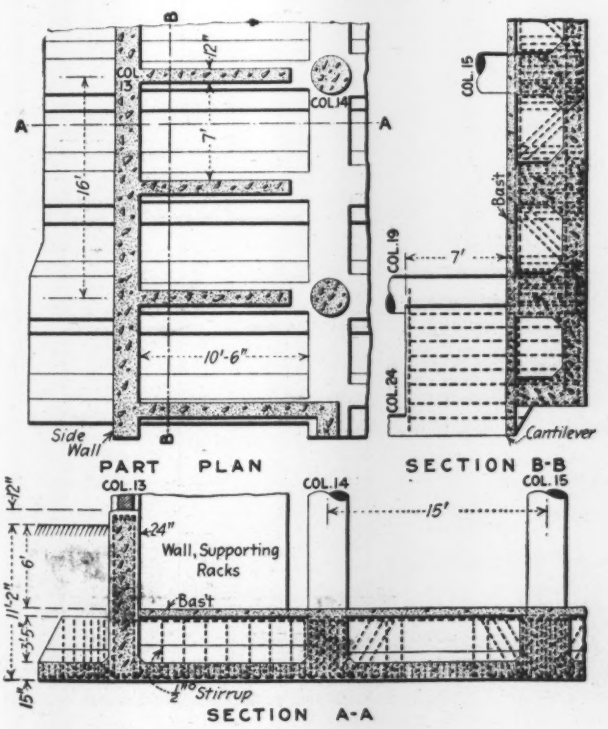
FIVE-STORY FACTORY AT CAMDEN, N. J., CARRIED ON FLOATING FOUNDATION

jected therefore to unusually heavy loadings, in some cases reaching 2000 lb. per sq.ft. and in no case being below 600 lb. per square foot.

The foundation is a cellular mat of reinforced concrete placed upon the stiff blue Chicago clay, no piles being used. It is estimated that this clay will carry safely a load of 4000 lb. per sq.ft., and the actual load at the base of the foundation will come well within this figure. The floor area is only 45 x 75 ft., but in order to increase the bearing area the foundation mat is made wider than the building. Its width over all is about 55 ft., projecting 6 ft. beyond that side of the building where the heaviest loading will be placed, and 4 ft. on the other side. This is shown by the drawing. At the corner of the building where the elevator and stair shaft are situated the mat is omitted and the columns have large spread footings. At the rear of the building, which adjoins an existing structure, some of the wall columns (in the party wall) are supported on cantilever brackets extending 2 ft. outside the foundation girder.

The mat is 4 ft. 8 in. deep, with beams and girders in both directions on a continuous bottom slab 15 in. thick. The girders are 24 to 42 in. wide. They are 41 in. high above the slab, except that the outer girders, which carry the side walls, are built up to a height of 12 ft. The cells between the girders, 41 in. deep, will be filled with cinders and covered with a 6-in. slab forming the basement.

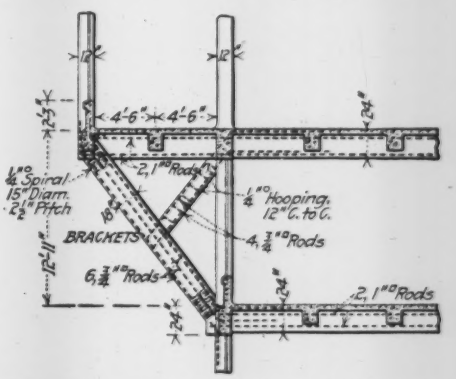
The Chicago building was designed by L. G. Hallberg & Co., architects of that city, and was built by the Mueller Construction Company.



CHICAGO BUILDING'S FLOATING FOUNDATION OF REINFORCED CONCRETE

Upper Floor of Concrete Building Carried on Bracket

IN THE reinforced-concrete building for the Farr & Bailey Manufacturing Co., referred to in the foregoing article, it was necessary to provide on the fifth floor a greater space, for the examination of the linoleums made by the company, than the ground area of the building permitted. This floor and the roof, just above, therefore were extended beyond the north building line 10 ft. by means of reinforced-concrete brackets, cast at the same time as were the columns and floor. The bracket construction was tied into the building proper by rods extending along and inside the girders, to beyond the second line of columns of the building, as shown in the accompanying drawing and view of the building.



HOW FLOOR BRACKET FOR BUILDING WAS DETAILED

Biggest Lumber Order in History

More than 400,000,000 ft. of Southern pine (approximately 20,000 carloads) has been purchased by the Federal Government through the Southern Pine Emergency Bureau for the war needs of the nation here and abroad, according to figures compiled by the Bureau. This is additional to about 375,000,000 ft. of timber being placed through the Bureau for the construction of 250 ships. The total makes by far the biggest lumber order in the history of the world.

Truck Heavy Submarine Sections Through New York Streets

Fifty to Sixty-Ton Pieces of Captured Mine Layer Carried on Four Wheels Without Injury to Pavements

PERHAPS THE HEAVIEST loads ever carried on four wheels through city streets in this country were handled recently in moving the German mine-laying submarine UC5 from 132nd St. and the North River, New York City, to 66th St. and Central Park West, where the boat is being reassembled and used to aid the sale of Liberty Bonds. Carried on a special steel-frame truck, itself weighing 15 tons, the three heavy sections, weighing 50, 55 and 60 tons, respectively, did remarkably little damage to various types of pavements.

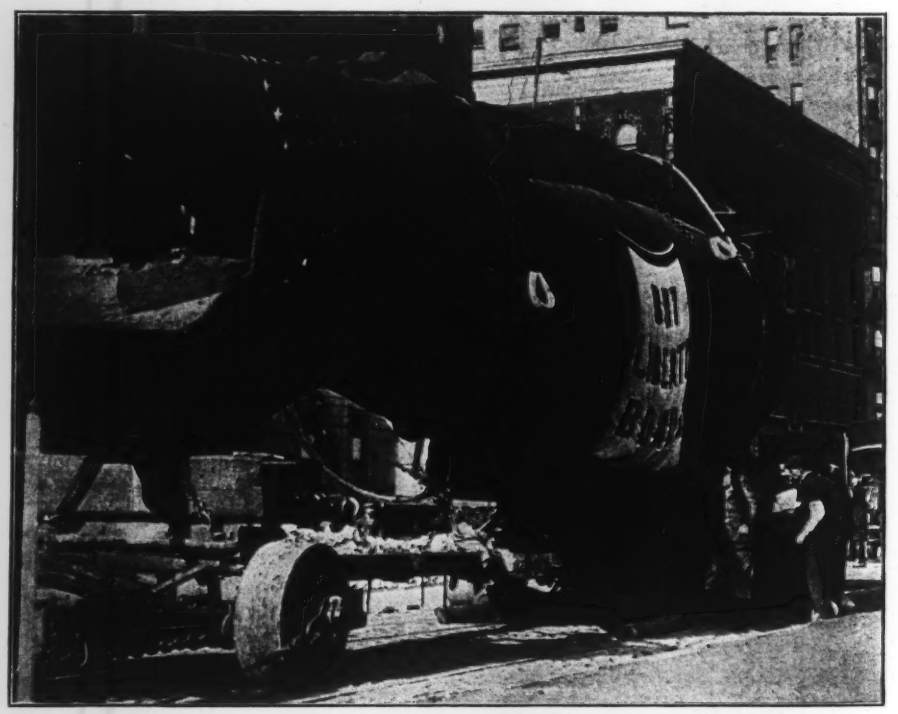
As announced in the daily papers, the submarine, which was lent by the British government to the New York Liberty Loan Committee, was used to advertise the sale of Liberty Bonds during the final week of the loan. The boat, originally of 200 tons displacement on 8-ft. draft, perhaps 35 tons of which were cargo and fuel capacity, was captured in April, 1916, off the coast of England, while full of contact mines, and after an attempt to destroy her by dynamite had been made by her crew. Originally built in three sections for transportation over land to a captured Belgian port, she was readily taken apart after dangerous work in securing the contact mines, which had been displaced in her hold by the explosions. Her three sections were sent to New York in the hold of a cargo vessel. The original cradles of 12 x 12-in. timbers and the pair of 2-in. galvanized wire rope slings used in handling each section by the British Admiralty are still on the boat and were used in removing it from the ocean steamer to lighters and in transferring each section in turn to the truck at 132nd St. This work was done by the Merritt & Chapman Derrick and Wrecking Co.'s 175-ton floating crane.

The submarine is 110 ft. long and 11 ft. in diameter. With a 1-ft. timber bolster under the keel, the top of the superstructure on the two end sections rode about 17 ft. above the street, while the center section with the conning tower and periscope was several feet higher. On account of the wrecking of the interior of the boat by the attempt to destroy her, and uncertainty as to the exact original displacement of the boat without cargo, it is difficult to estimate accurately the present weight of the sections, but the back section, 45 ft. long and the first one moved, is thought to weigh at least 55 tons. The center section, entirely cylindrical and 22½ ft. long, is believed to weigh at least 50 tons; and the bow section, 42½ ft. long, and of full diameter almost to the nose of the boat, to weigh more than 60 tons.

The heavy reach truck used was set so that the bolsters registered with the cradles under the section to be hauled. These cradles and the section itself were secured against sliding or rolling by two chains to each cradle, and two chains or wire ropes to each end of the section, all tightened with turnbuckles or steamboat ratchets. The truck is of about 8 ft. gage, and as these lashings were kept under a heavy strain, being tightened as often as they worked loose, none of the loads manifested any tendency to shift or turn over.

The hauling was done by horses, one pair of wheel horses being hitched to the truck tongue, and two lines of 20 teams each being attached to a yoke in front of the tongue by two 1¼-in. wire-rope cables attaching either end of a cable to one end of the front axle of the truck.

The route followed was across the New York Central R.R. tracks at the Fort Lee Ferry and down Manhattan St. over granite block paving to 125th St.; then along 125th St. over asphalt paving to 7th Ave.; down 7th Ave., over asphalt and asphalt block paving, to 110th St.; west along 110th St. over asphalt to Central Park West; thence over asphalt paving and car tracks paved with granite block to the 66th St. entrance of Central Park. Here the loads were taken a short distance over the asphalt driveway and down a plank roadway laid on the grass, to the final location. The only difficulty experienced was with the first load at 103rd St. and Central Park West, where a washout, caused by the



STERN SECTION, FIRST TRANSPORTED, FOUND WEAK SPOT NEAR OLD WATER MAIN WASHOUT

FIFTY-TON CENTER SECTION LEFT NO MARKS ON ASPHALT

bursting of water main some months before, had left a weak spot in the pavement between car tracks, through which the left rear wheel of the truck settled several inches. The heaviest section, transported when the temperature was about 50°, made no impression on the granite-block pavement and did not leave any perceptible marks on the asphalt or asphalt-block sections. The four wheels on the big truck are alike, each with 14-in. flat tread, rounded to ¼-in. radius at each edge. They are of cast steel, 30 in. in diameter, and weigh 2 tons apiece. The wheels are set on steel axles to about 8 ft. gage. Remarkably few manhole covers were broken, one load running over a number on Manhattan and 125th Sts. without causing any damage.

The streets along the route selected are almost level, but to guard against accidents a pair of wagons were hitched to the rear of each load with chain as a hold-back, and a short sled of 10 x 12-in. timbers was hung under the rear axle. These timbers swung just below blocks on the under side of the axle, and their rear ends dragged the street. Their front ends were carried a few inches above the pavement, so that by throwing a heavy timber under the sled it would be possible to stop the truck within a very short distance. Most of the time, however, the truck was guided and checked by putting wood blocks under the wheels.

On reaching the park the first section was jacked up off the truck and lowered to timber cribbing after the truck had been removed. In bringing up the second section the teams were split on each side of the first and the truck was stopped with the sections about 20 ft. apart. The tongue and the wheel horses were then taken out, a six-part manila rope fall-rigged, and the section pulled to within 3 ft. of the first. The second section was then raised and the truck removed as before. The bow section was placed in the same way, the space between sections being left on purpose in order to make it easy for the public to gain access to the interior of the submarine.

The work was carried out by the Snare & Triest Co. under the direction of W. G. Triest. The special truck, teams and drivers were furnished by the Meade Transfer Company.

New Haven Tests Five Processes of Sewage Treatment

Activated Sludge, Imhoff Tank, Miles Acid Tank, Screening and Chlorination Studied at Experiment Station

FIVE PROCESSES of sewage treatment are being investigated at a sewage-experiment station established by the City of New Haven, Conn. The processes are: Activated sludge; Imhoff sedimentation and digestion tank; Miles acid tank for recovery of grease and fertilizing material; screening; disinfection by liquid chlorine. The following statement regarding the reasons for the experiments and description of the plant are taken from a paper by F. W. Mohlman, chemist and engineer-in-charge of the sewage experiment station, read at the recent Boston meeting of the American Chemical Society:

Reasons for Investigations

"In the summer of 1916 representatives of the United States Public Health Service, under the direction of Dr. H. S. Cumming, made an investigation of the sanitary condition of New Haven harbor. They found that it was seriously polluted by the sewage and industrial wastes of New Haven. They recommended that the taking of shellfish from the harbor be prohibited, that bathing be prohibited and that the city take steps to insure the proper disposal of the sewage. Following these recommendations the city council appropriated a sum of money for the establishment of a sewage-experiment station and a citizens' committee was appointed to take charge of the work. Prof. C. E. A. Winslow of Yale University is the chairman of this committee and the director of the experiments. During his absence in Russia with the Red Cross Commission Henry B. Sargent is chairman of the committee. The plant was designed by Prof. S. E. Barney, Yale University, assisted by R. H. Skelton. The writer is chemist and engineer-in-charge of the station, with W. S. Sturges as bacteriologist. Continuous operation started in June of this year.

"New Haven is an important manufacturing city of 150,000 inhabitants. The sewerage is on the combined system. Wastes from most of the larger factories are discharged into the East St. sewer, which has an average dryweather flow of 13,000,000 gal. per day. Since it was thought that tradewastes might interfere with the treatment of this sewage it was decided to locate the experiment station at the outfall of this sewer.

"The sewage for the testing station is pumped by a bucket-elevator, which was erected in a concrete forebay at one side of the sewer. The sewage is deflected into the forebay by a galvanized-iron deflector built out nearly to the center-line of the sewer, and flows back into the sewer at the lower end of the forebay.

It was believed that a fair sample of the sewage could be obtained in this way, including the floating solids and grease, and that the suspended solids would not be broken up to as great an extent as if a centrifugal pump were used.

"Operation of the elevator has shown that it fulfils these expectations. The elevator delivers approximately 150,000 gal. of sewage per day into a hopper-shaped receptacle from which it flows over to the station through a wooden flume. Before flowing into the weir-box, where it is measured, the sewage passes through a grit-chamber 15 ft. long, 12 in. deep at the inlet end, 4 in. deep at the outlet end and 4 in. wide, with a detention period of 0.24 minute. The velocity of the sewage is checked to 0.7 ft. per second at the inlet end, increasing to 2.1 ft. per second at the outlet end. This velocity is so high and the detention period so short that very little grit has been removed from the sewage.

"Beyond the grit-chamber there is a butterfly valve in the flume which is automatically controlled by a float in the weir-box. This butterfly valve keeps the sewage at a constant level in the weir-box, the excess sewage being deflected over weirs 4 ft. long cut in the sides of the flume. The apparatus for maintaining a constant level was constructed by Wallace & Tiernan, New York City.

"From the weir-box the sewage flows to the various tanks over adjustable weirs, small amounts of 10,000 gal. per day being measured by 60° V-notch weirs and 100,000 gal. per day by a rectangular weir 7½ in. long.

Processes Under Investigation

"The activated-sludge experiments are on the continuous-flow basis. The aërating tank is 16 ft. long, 4 ft. wide and 8 ft. deep. At the bottom of the tank the sides slope at 45° to a trough 1 ft. wide which runs the full length of the tank. An iron frame in which are cemented 15 filtros plates is cemented into this trough. The air is admitted at the inlet end of the trough and the water which filters through the plates can be drawn off at the outlet end. Air at 3.5 lb. pressure is supplied by a Nash hydro-turbine having a capacity of 20 cu.ft. of free air per minute. It is measured by means of a venturi tube.

"The settling tank is 4 x 4 ft. in plan, and 12 ft. deep to the bottom of the hopper. The hopper slopes at 60° to a sump in which is cemented a 3-in. ell connected to the suction of a centrifugal pump. Sludge is pumped back to the aërating tank, where it is measured in an orifice box. A baffle 7½ ft. deep extends across the center of the settling tank. This baffle was first placed 3 ft. from the inlet weir and 1 ft. from the outlet weir, but the upward velocity of the effluent carried particles of sludge over the outlet weir. Since placing it in the center of the tank no sludge has been lost in this way. The theoretical upward velocity is now 2.4 in. per minute and was formerly 4.8 in. per minute. The capacity of the aërating tank is 3100 gal. and of the settling tank 1150 gal. At present, while treating 17,000 gal. of sewage per day with 50% as much sludge returned, the aëration period is 3 hr. and the settling period 1.1 hours.

"The Imhoff tank is 16 ft. long, 4½ ft. wide and 11½ deep. The flowing-through chamber extends the full length of the tank, with gas vents 8 in. wide on ea side. The capacity of the tank is 840 gal., giving detention period of 2 hours when treating 10,000 g of sewage per day.

"The Miles tank is 16 ft. long, 3½ ft. wide and 4 deep and has a capacity of 1680 gal. When treatir 10,000 gal. per day the theoretical detention period 4 hours. Liquid sulphur dioxide in cylinders is use for acidifying the sewage, supplemented at times b gas produced by a sulphur burner.

"Screening experiments were planned with the ex pectation that an experimental Riensch-Wurl screen could be obtained, which was to be operated at the rate of 100,000 gal. per day. In view of the impossibility of obtaining this screen, experiments with a mechanically-operated screen had to be abandoned. Fixed screens of 30-mesh monel metal wire cloth are used in a screen chamber through which raw sewage flows at the rate of 100,000 gal. per day. The screens are removed when the loss of head reaches 2 ft., and are cleaned by hand. The operation of the screens is discontinuous, approximately 3000 gal. of sewage being screened for one experiment.

"The effluents from the Imhoff tank, activated-sludge tank, and screenng chamber run through baffled tanks, where they are treated with liquid chlorine. The periods of detention are from 2 to 5 min."

Old Brick Road Resurfaced with Thin-Base Monolithic Brick

Use of 3-Inch Block Proves Satisfactory—On Future Work the Experimental Use of a Two-Inch Paver Is Proposed

By Harlan H. Edwards
Highway Engineer, Danville, Ill.

SOME UNUSUAL details of design and construction, involving the use of an old brick pavement as the foundation for a new wearing surface, were embodied in a new monolithic brick pavement laid during the past summer near Danville, Vermilion County, Ill., under the direction of William S. Dillon, county highway superintendent. The work lay along what is locally known as the Batestown road, approximately a mile west of Danville along the Big Four Ry. The Batestown road carries very heavy traffic from coal mines and brick plants as well as the through traffic from Champaign and other points farther west. It was paved about 15 years ago with an inferior grade of brick, laid on a poor concrete foundation, and had worn rough and uneven under the heavy traffic. Since the funds for reconstruction were limited, the problem was to obtain the best and most durable surface for the money available.

After careful consideration had been given to brick, concrete, asphalt and tar as possible resurfacing materials, brick was selected as being most suitable and permanent for the heavy traffic. It was then necessary to determine the most economical method of construction. Since the monolithic type was most easily adaptable to this job, after much thought and consultation with other engineers, Mr. Dillon designed the brick pavement to be

FIG. 1. FIFTEEN-YEAR-OLD BRICK PAVEMENT, BUILT OF INFERIOR MATERIALS, WAS UNFIT FOR HEAVY TRAFFIC.
FIG. 2. CONCRETE FOR THE NEW THIN BASE WAS DELIVERED FROM THE 2-FOOT MIXER BY WHEELBARROWS.
FIG. 3. A WOODEN TEMPLET SHAPED THE BASE FOR THE PAVING BLOCKS. FIG. 4. WITH THE THIN BASE THE NEW BRICK SURFACE WAS UNUSUALLY SMOOTH

laid and grouted on a thin, fine-gravel concrete base, spread to a uniform surface over the old brick road. Specifications were drawn up and the contract for the construction of 10,270 sq.yd. was let to William Ray, of Danville, for a unit price of $1.65 per square yard.

Several features of this work facilitated rapid and almost continuous construction and required at the same time but a small outlay for equipment. Since the old pavement furnished a firm and unyielding foundation, no earthwork was needed. Moreover, there was no waste of materials such as is caused by piling on an earth subgrade. Again, the old pavement furnished a foundation unaffected by rain, so that operations could be resumed very shortly after a downpour. Finally, because of the thin layer of concrete used, a small mixer (2 cu.ft. capacity) operated by two or three men easily kept ahead of the brick gang, laying about 250 ft. of 16-ft. pavement in a day.

As shown in the accompanying illustrations, the method of construction consisted of placing a thin layer of pea-gravel concrete upon the cleaned surface of the old pavement, and laying and grouting the brick thereon. The sand and gravel were hauled and dumped in sufficient quantity upon the old brick pavement, while the bricks were piled along the edge of the road in regular order for laying. Most of the pavement was laid with a 4-in. Danville wire-cut-lug block, but for the western 700 ft., 3-in. Danville pavers were used, reducing the unit price of $1.65 to $1.55 per sq.yd. The concrete was a 1:4 mix, containing a fine, well-graded gravel ranging from that which will pass a ½-in. revolving screen down to fine sand.

After the surface of the old 18-ft. brick roadway was cleaned thoroughly by brooming, 5-in. wood forms were placed and braced true to line and grade 16 ft. apart, and the concrete, slightly stiff, was carried from the mixer and dumped in place by wheelbarrows. After it was spread to a virtually uniform surface, it was struck off to a 2-in. crown with a hand-drawn wooden templet, and upon this fresh surface the bricks were laid immediately.

The bricks were carried from the piles to the pavement on boards or wooden pallets, and placed in regular order so that with minimum effort they could be laid in the pavement best face up and lugs to the rear. After the necessary inspection was made and the soft, rough or broken bricks were removed or turned over, the bricks were rolled to a smooth, even surface with an 800-lb. water-ballast hand roller and grouted immediately. All work was carried on within 100 ft. of the mixer.

By the use of this thin layer or base of concrete a more smooth and even surface was obtained than is usual with the thicker base types of the monolithic brick pavement. With them, unless extreme care is taken to insure (1) a proper gradation of aggregate, (2) uniform consistency of concrete, (3) proper striking-off of the concrete base and (4) intelligent rolling of the brick, a wavy, uneven surface is too often the result. In this case, however, although the thickness

of the concrete varied from ½ in. to 4 or 5 in., according to the depth of the holes in the old pavement, the concrete was of such consistency and composition that smoothness was obtained with little effort. This is an important item, because the universal use of the motor vehicle creates a public demand for smoothness as well permanence.

Though the use of paving brick as a resurfacing material for old, worn pavements is probably not new, this type of construction, as designed by Mr. Dillon, is a novelty and a starting point for similar work. Though here this new surface was laid on an old brick pavement, it is equally as well adapted for resurfacing concrete, macadam, asphalt, or any other similar type of worn pavement, provided a solid foundation is afforded thereby. The use of the 3-in. brick has proved a success here as well as in previous construction, and in order to reduce further the cost of such work and eliminate unnecessary use of material, the experimental use of a 2-in. paver on this sort of work is proposed for part of a resurfacing job to be undertaken next year. Though some engineers scoff at such work and predict failure, many of those well acquainted with this type of construction think that the old pavements, pounded down by years of hard usage, will provide ample foundation for a thin brick surface laid monolithically.

Standard-Type Bunk-Houses Built by Railroad

Pennsylvania's Unit System of Portable Buildings Provides Comfortable Quarters at Economical Cost

SUDDEN DEPLETION of the fixed labor supply, due to the war, forced the Pennsylvania R.R. to solve the housing problem in some adequate way, in order to hold replacements made. This condition brought to the company a large importation of alien labor, most of it men who had no homes, so A. E. Owen, chairman of the road's camp committee, told the sixth annual Conference on Housing in America held in Chicago Oct. 15, 16 and 17. The following is an abstract of Mr. Owen's address:

The first question that arose was, How should these men be housed? The matter presenting an entirely new phase of labor difficulty, it was quite natural that the utilization of every available building and freight car should be considered first, because at that time the condition was believed to be only temporary. The officials have since changed their minds on this point. The result, however, was a variety of bunk-houses, some of which meet the requirements very well while others do not. When it was realized that the new conditions were approximately permanent, a careful study was made, to determine the best kind of bunk-house to use—keeping in mind, first, comfortable quarters for the men; second, efficiency and economic construction and third, general utility. Finally, a plan was submitted, which, after many actual service trials were made, was approved. A standard plan then was adopted.

The buildings are of the portable type, constructed of the ordinary tongue-and-groove white pine. They are built in sections 10 ft. long by 20 ft. wide, with sloping roofs. It is 16 ft. from the floor to the ridge-pole, and the floors are raised about 18 in. from the ground on suitable piers. The entire exterior of the buildings is covered with a pebble-dash roofing paper. The unit method makes it quite a simple matter to increase or decrease the size of a building. The units can be stored conveniently, or they can be moved without serious difficulty. General economy and adaptability to emergency use are also points not to be forgotten. In order to conform with the fire regulations, these quarters are lighted by electricity, and each building is equipped with the proper number of fire extinguishers. Screens for the windows and doors are also provided, and the company prides itself on having waged a successful war on flies and other vermin. The camp inspectors are looking constantly after these nuisances, as well as seeing that dirt, grease or refuse of any kind is not allowed to accumulate. Instructions are given to burn or bury all such litter.

A regular standard double-deck bunk is used in these dormitories. Each bunk is supplied with two blankets, pillows, pillow cases and a sheet. The blankets, mattresses and pillows are aired frequently and sprayed with an approved insecticide. Pillow cases and sheets are sent to the laundry, and floors are scrubbed at least twice a week with a disinfectant solution, besides being mopped or swept daily. The cuspidors are cleaned daily and a disinfectant solution is added. Wherever it is possible, a separate locker containing soap and individual towel is provided for each man.

In each of these buildings stationary wash stands are provided, with hot and cold water, and where camps are large enough and drainage is available, shower baths are provivded. It is the aim of the company to provide eventually this facility at the smallest camp.

Probably the most important point in the maintenance of labor and labor camps is food. As the best that can be had is offered, the turnover is extremely heavy. The men have the opportunity to obtain credit, and are allowed the privilege of purchasing, at cost, clothing, shoes, tobacco, etc. The bunk-room and the meals are virtually donated, although it is true that the company receives a small amount in return.

In the larger camp a separate building is used for a commissary or store, where small quantities of foodstuffs are carried for general consumption. This plan is being carried out gradually in the smaller camps. The kitchens are equipped on about the same plan as are hotels. Bills of fare have been introduced, with menus of excellent variety of good, wholesome food. Good cooks are employed to prepare the food properly, and it is served by waiters. A second helping is permitted.

Gradually the camps are being enlarged to include recreation rooms, something to give the men opportunities to amuse themselves, a central point where they may gather and pass the time when not out on the tracks. Various forms of amusements are provided at this time, but no standard plans have been drawn up, because the various nationalities require different forms of amusement.

The company medical department has been enlarged to look after the general sanitation of the camps and the health of the men.

Field Tests Made on Oil Treatment of Wood Against Marine Borers

Forest Service and Fish Commission Studies of Creosote Oil Protection on Specimens Immersed Six Years Indicate Need for High Boiling Oils and for Complete Protection

By C. H. Teesdale and L. F. Shackell
United States Forest Products Laboratory, Madison, Wis. Professor of Physiology, University of Utah, Salt Lake City

FOR a number of years the U. S. Forest Service, in an effort to overcome the destruction of timber by marine borers, has been investigating methods of treatment and efficiency of various preservatives, taking records on actual service tests. At the same time the U. S. Bureau of Fisheries has been studying the life histories of the various borers. Since 1914 these bureaus have been working jointly on the problem, and have published annual reports of progress in the *Proceedings* of the American Wood Preservers' Association for 1915 and 1916. The results of further experimental studies on various kinds of preservatives—that is, after six years' service—and the observation of certain rarely noted peculiarities of borers are the subjects of the present or third report.

For hundreds of years search has been made for an efficient protective against the attacks of marine borers. During the past 50 years the use of creosote oils, particularly those obtained from coal tar, has made great headway, until at present impregnation under pressure with coal-tar creosote may be considered a standard method of preserving piling. This method is, however, expensive, and its effectiveness by no means invariable.

For example, 12 years is about the average life obtained from piling given an 18-lb. treatment and installed at Pensacola, Fla., and it is the practice of one of the railroads in that territory to use a tile protection around creosoted piles where renewals are very expensive. The sections in one of the views were taken from a creosoted longleaf pine pile destroyed by xylotrya at Gulfport, Miss., after 11 years' service. Another view shows a pile badly damaged by sphæroma at Mayport, Fla., after 12 years' service. It was in somewhat worse condition than the average pile in the structure of which it is a part.

There is an element of uncertainty in all except, perhaps, the heaviest treatments. Coal-tar creosote is a highly complex mixture of organic compounds, no two creosote oils being identical in composition; and methods of analysis are limited mainly to fractional distillations carried out under arbitrary conditions, together with determinations of a few physical constants. Furthermore, it has not been known whether the effectiveness of a creosote oil against marine borers is due to its toxic constituents, to its viscosity, to high-boiling, practically non-volatile compounds or to some combination of the foregoing. The development within recent years of a ready market for individual constituents of creosote—the phenols, naphthalene, tar bases and so forth—has led to the widespread use against marine borers of oils from which these constituents have been in part removed, so that the composition of the oils must be widely different from that of the straight distillate oils used 20 to 50 years ago, and it is uncertain how the effectiveness of the oils is impaired. It is these early oils, however, that have furnished the service data on which has been based the reputed effectiveness of creosote oils in general.

The first series of tests under the auspices of the Government bureaus was started in 1911 and 1912 with treated specimens of Southern yellow pine, each about

(Above)—Two sections on longleaf pine pile at Gulfport, Miss., 1902-1913, destroyed by teredo. Uneven penetration probably caused failure. Left-hand section at water surface. Right-hand section at mud line. (At left)—Longleaf pine pile attacked by sphæroma after 12 years' service at Mayport, Florida

HOW CREOSOTED PILES IN SOUTHERN WATERS ARE ATTACKED BY MARINE BORERS

TABLE I. SUMMARY OF ALL TESTS OF VARIOUS PRESERVATIVE OILS, 5 TO 6 YEARS' SERVICE

Preservative	No. of Specimens	Condition: No Attack	Very Slight Attack	Slight Attack	Medium Attack	Severe Attack	Very Severe Attack	Destroyed	Lost
Fraction I	16	..	..	..	..	8	6	2	..
Fraction II	16	..	..	..	2	5	4	4	1
Fraction III	16	..	..	3	6	4	1	2	..
Fraction IV	16	..	2	7	5	..	1	..	1
Fraction V	16	..	5	3	7	..	..	1	..
Coal-tar creosote	20	..	..	5	14	..	..	..	1
Copperized oil	8	..	..	..	..	1	..	7	..
Water-gas tar creosote	8	..	..	2	4	2	..	..	..
Hardwood tar	8	..	..	..	..	..	..	8	..
Timber asphalt	8	..	..	..	..	..	..	8	..
Untreated	24	..	..	..	..	..	..	24	..

6 in. in diameter and 2 ft. long. Specimens treated with coal-tar creosote fractions were installed at Pensacola, Fla., Gulfport, Miss., and San Francisco, and specimens treated with various other preservatives were installed at Gulfport and San Diego. Table I shows a summary of the results of inspections made from September, 1916, to January, 1917, after the specimens had been in service for periods varying between five and six years.

A second series of tests was started by installing additional specimens in 1914 and 1915, and the condition of these at the same inspection is shown in Table II.

The pieces treated with coal-tar creosote fractions in 1911 were given an absorption of 18 lb. per cu.ft., and the later ones an absorption of 8 lb. per cu.ft., but all are grouped together in the summary. Table III shows the physical and chemical properties of all the preservatives used in these experiments.

High Boiling Oils Seem Most Effective

Comparing the results obtained on the five fractions of creosote, it will be noted that there is a progressive increase in resistance to attack as the boiling point of the preservative is raised. Thus, all of the specimens treated with fraction I were either severely attacked or destroyed, while only one of fraction V was destroyed. Those treated with coal-tar creosote were about comparable to those treated with fraction IV. The high boiling water-gas tar creosote was almost as effective as coal-tar creosote. With the other preservatives used it will be noted that copperized oil, hardwood tar, timber asphalt and spirittine were not at all effective. Hence, it is concluded that products of petroleum and of the distillation of hard and soft woods are not effective in preventing attack by marine borers.

TABLE II. CONDITION OF SPECIMENS INSTALLED AT GULFPORT AND PENSACOLA IN 1914 AND 1915 AND INSPECTED IN FEBRUARY, 1917

Treated With	Description of Attack by Borers: Sound or Very Slight	Slight	Medium	Medium Severe	Severe	Very Severe	Destroyed	Not Inspected
Installed at Pensacola in January, 1914								
Spirittine	..	..	..	..	..	2	2	..
Water-gas tar, 1.051	..	..	1	..	2	1	..	..
Water-gas tar, 1.012	..	..	..	2	..	2	..	..
Crude oil and $ZnCl_2$	..	..	..	..	..	1	2	1
Creosote and ferric chloride	1	3	..	..	..	..	..	..
Creosote and copper	1	2	..	..	..	1	..	..
Crude oil and copper	..	..	..	..	1	..	3	..
Installed at Pensacola and Gulfport in January, 1915								
75% creosote, 25% naphthalene	..	5	1	..	..	..	..	2
50% creosote, 50% naphthalene	2	4	1	..	1	..	..	..
75% creosote, 25% tar	2	3	2	..	..	..	..	1
50% creosote, 50% tar	4	3	1	..	..	..	..	..
Creosote	3	1	..	..	..	..	..	..
1% crude ferric acetate	..	..	..	..	..	..	3	..
5% crude ferric acetate	..	..	..	..	..	..	2	..

The later experiments indicate that low boiling water-gas tar distillates are ineffective. Zinc chloride or copper salts added to crude oil were of little value, while ferric chloride or copper salts added to creosote considerably increased the resistance, especially to limnoria attack. Naphthalene added to creosote decreased its resistance to the borers, especially limnoria. While Table II indicates that additions of tar to creosote reduced the resistance to attack, this was due to the fact that the tar increased the difficulty of penetration, and with the low 8-lb. absorptions resulted in narrow, poorly penetrated strips near the surface, in which the borers obtained a start. Where the specimens were well treated the general surface conditions indicated that tar increased the resistance to attack to a considerable extent. Ferric-acetate solutions were of no value.

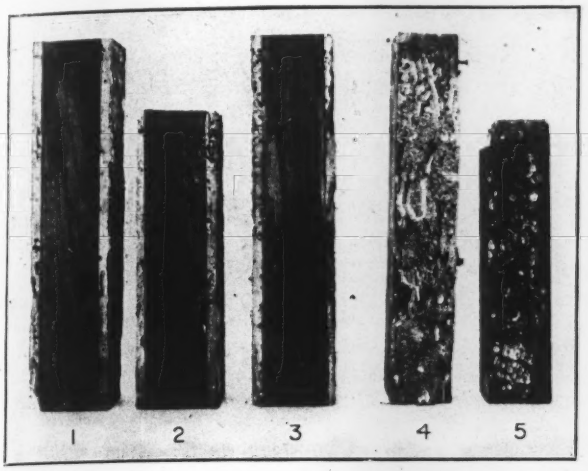
The shipworm, xylotrya (often confused with a less common relative, teredo), is perhaps the most destructive borer in American waters, and though a microscopic organism at the time of its entrance into a piece of wood, may attain a length of several feet and a diameter of an inch. Widely different from this mollusc is the tiny crustacean borer, limnoria, which rarely attains a length above ¼ in., and yet because of vast numbers is fairly destructive. In spite of the great structural differences between these two forms their reactions toward creosote poisons were strikingly similar. This was determined from the following summary which applies equally to both xylotrya and limnoria. More than 1000 specimens of xylotrya and more than 12,000 of limnoria were used.

Investigation Made of Relative Values of Oils

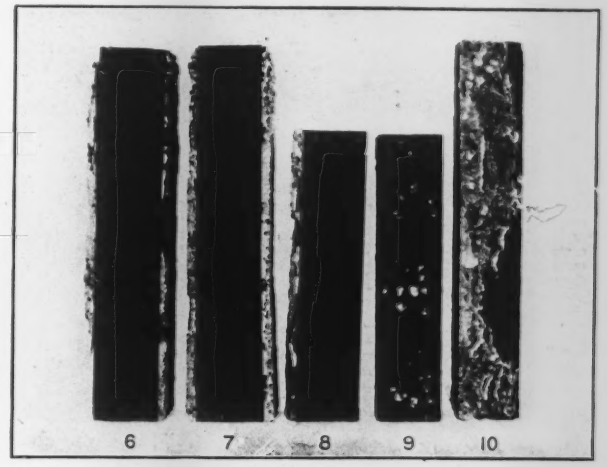
The preparations investigated consisted of the creosote and creosote fractions used in the above described service tests (see Table I), a series of creosote light oils; a series of tar acids, a series of tar bases and a series of crystalline coal-tar hydrocarbons. The light oils tested were benzol, toluol and a mixture of the isomeric xylols. The tar acids consisted of phenol, orthometa- and para-cresols and alpha- and beta-naphthols. The samples of mixed tar bases, which were furnished by S. R. Church of the Barrett Manufacturing Co., consisted of four fractions obtained by the Hempel distillation of crude bases. The temperature limits of these distillates were, respectively, 94° to 167° C., 170° to 210°, 210° to 250°, and 250° to 315°. Experiments were also made with a sample each of pure pyridine and of synthetic quinoline. The crystalline hydrocarbons studied were naphthalene, acenaphthene, phenanthrene and anthracene.

1. The toxicity of creosote fractions *decreases* as the boiling point rises; that is, the creosote and its distillates, arranged in the order of decreasing toxicities, are: Fraction I, fraction II, creosote, fraction III, fraction IV, fraction V. The high toxicity of fraction II, which was solid with naphthalene, was probably due mainly to tar acids.

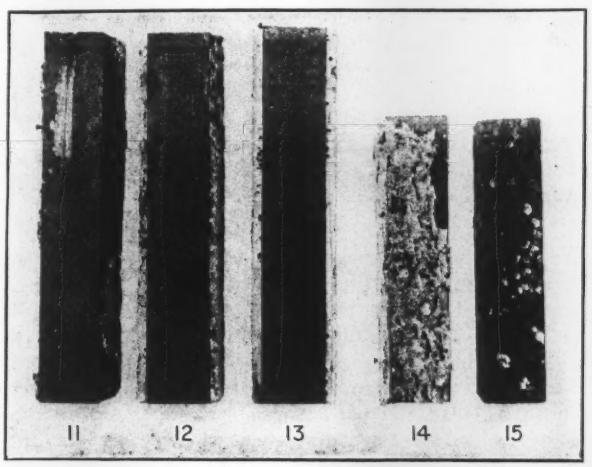
2. The creosote light oils are definitely poisonous for the borers. Benzol is the most and xylol the least toxic. The toxicity of toluol lies between these two.



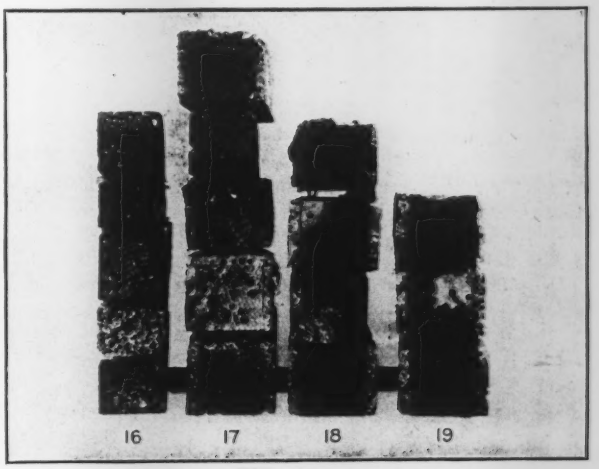
Heavy Treatments with Most Toxic Creosote Distillate—Fraction I
(1) 14.0 lb. (2) 15.3 lb. (3) 13.7 lb. (4) 13.1 lb. (5) Unsheathed control, 17.4 lb. oil per cu.ft. Sheathing practically destroyed; attack on treated cores though definite is superficial. No. 4 illustrates destructive attacks of xylotrya and limnoria on untreated sheathing. Unsheathed control not attacked. Patches on No. 5 are oyster shells and barnacles



Light Treatments with Straight Creosote of Medium Toxicity
(6) 5.6 lb. (7) 6.6 lb. (8) 10.8 lb. (9) Unsheathed control, 6.4 lb. (10) 4.1 lb. oil per cu.ft. Depth of borings average ¼ in. No. 9 not attacked



Light Treatments with Least Toxic Creosote Distillate—Fraction V
(11) 5.4 lb. (12) 7.9 lb. (13) 7.5 lb. (14) 5.7 lb. (15) Unsheathed control, 7.8 lb. oil per cu.ft. Attack on treated cores fairly general, but for most part extremely superficial. No. 15 not attacked



Sectional View Through Middle of Typical Specimens
Reading from top in each row, preservatives used in similar numbers of rows 16 and 17 were naphthalene, alphanaphthol, phenol, benzol, gas oil. Unsheathed controls in row 16. Row 18; fraction III, creosote, fraction I (light treatment), fraction I. (heavy treatment). Row 19; fraction II, fraction IV, fraction V. The lower three specimens, row 18, illustrate difficulty of treating heartwood and advantage of fact taken by borers

TESTS SHOW THAT MARINE BORERS PENETRATE UNTREATED SHEATHING IN MINUTE FORM AND WHEN THEY REACH FULL SIZE ATTACK THE TREATED WOOD BENEATH

3. The tar acids are all highly poisonous to the borers. Their toxicity steadily increases with rise in molecular weight; that is, arranged in order of increasing toxicity, they are: Phenol, the cresols and the naphthols. The three isomeric cresols, which exert practically the same degree of toxic action, are about twice as poisonous as carbolic acid; while the two naphthols, also equally toxic, are ten or more times as poisonous as phenol.

4. Tar-base fractions all show a high toxicity for the borers; and this toxicity increases with rise of boiling point of the fractions. Pure quinoline, boiling at 239° C., is several times as poisonous as pyridine, with a boiling point of 115°. The toxicities of the tar bases are fairly comparable with those of tar acids of approximately the same boiling points.

5. In comparison with the tar acids or bases or even the lighter hydrocarbon oils, the solid hydrocarbons of creosote are only very slightly toxic. Arranged in the order of decreasing effectiveness, they are: Naphthalene, phenanthrene, acenaphthene and anthracene. Naphthalene is perhaps five times as toxic as anthracene.

It has apparently been assumed that the more poisonous a creosote oil is the more effectively will it prevent attacks of marine borers. It will be noted, however, that the conclusions drawn from these direct toxicity tests, especially with reference to creosote and its fractionates, are diametrically opposed to the conclusions drawn from the service tests above; that is, the highest boiling fraction, which was the least poisonous, stood up the best in actual service. But it does not follow that some of these observations must be inaccurate, nor

TABLE III. PROPERTIES OF PRESERVATIVES USED IN GOVERNMENT WOOD BORER TESTS

Preservative	Specific Gravity at 60° C.	Per Cent. Distillation (Hempel Column). Degrees Centigrade: To 170	170 to 205	205 to 255	255 to 295	295 to 320	Above 320	Highest Temperature Reached	Residue	Loss	Remarks
Coal-tar creosote I	1.048		11.0	35.9	14.8	12.4	....	320	25.8	0.1	
Fraction I	0.934	28.6	34.8	27.0	....	....	....	225	8.1	1.5	Collected between 0 and 205° C.
Fraction II	1.003	0.9	8.1	76.4	10.5	....	....	287	4.0	0.1	Collected between 205 and 250° C
Fraction III	1.045	0.2	0.5	29.2	43.8	11.3	8.8	337	5.8	0.4	Collected between 250 and 290° C.
Fraction IV	1.088	....	....	1.4	21.7	31.5	23.1	335	22.5	0.1	Collected between 290 and 320° C
Fraction V	1.15	....	....	....	2.4	7.7	38.6	360	51.2	0.1	Residue above 320° C.
Water-gas tar creosote 1	0.995	....	6.9	39.4	29.0	5.0	11.7	350	7.6	0.4	Water-gas tar distillate.
Water-gas tar creosote 2	1.042	....	5.5	20.7	17.5	10.0	23.9	360	21.9	0.5	Water-gas tar distillate.
Water-gas tar creosote 3	1.058	....	4.9	2.9	9.3	10.5	36.9	350	35.0	0.5	High boiling water-gas tar distillate oil.
Hardwood tar	1.195	27.0	3.1	20.9	10.0	....	....	244	46.8	2.2	A tar product in distillation of hardwoods. Contained 24% water.
Timber asphalt	1.063	....	....	....	17.9	30.5	27.1	345	20.2	4.3	A residuum of petroleum.
Copperized oil	0.937	....	....	....	19.4	28.71	30.82	358	17.5	3.6	(1) To 340, contained 10% saponifiable oil removed before distillation. (2) 340 to 358, contained 0.34% copper.
Spirittine	1.006	....	22.1	13.2	4.4	....	....	295	56.9	3.4	A product of the distillation of Southern pine.
Creosote from which five fractions were distilled		2.0	7.0	43.0	16.0	4.5	....	315	27.6	0.9	Analysis by retort method contained 0.9% water.
Coal-tar creosote II	1.071	....	1.2	31.7	14.5	15.2	....	360	36.9	0.5	Contained some undistilled tar. Residue above 360 was 20.9
75% coal-tar creosote II and 25% crude naphthalene	1.063	....	0.5	40.8	11.0	12.1	....	330	35.1	0.5	
50% coal-tar creosote II and 50% crude naphthalene	1.064	....	0.5	46.8	10.0	12.4	....	330	30.0	0.3	
75% coal-tar creosote II and 25% byproduct tar	1.108	....	2.6	24.5	12.7	12.8	....	330	46.9	0.5	
50% coal-tar creosote II and 50% byproduct tar	1.139	....	1.6	18.7	9.3	13.1	....	330	56.8	0.5	
		To 190	190 to 275	275 to 300		300 to 320					
Crude oil	0.873	0.0	16.5	17.0	....	17.0	34.8	365	....	...	
Zinc Cl solution	1.048	20°C	....	....	....	....	....	....	....	....	
Creosote, $FeCl_3$ mixture	.....	....	....	....	....	....	....	....	....	....	Per cent. ferric chloride in mixture 0.88
Copperized coal-tar creosote	.....	....	....	....	....	....	....	....	....	....	Per cent. copper in mixture 0.879.
Copperized crude oil	.....	....	....	....	....	....	....	....	....	....	Per cent. of copper in mixture 0.654

that toxicity is not a factor in the preservative action of creosote oils. It seems worth while to consider this point in some detail, if only to show how involved is this problem of marine borers.

The data for the first six preservatives, Tables I and III, indicate that the practical efficiency of these preservatives is a function of the high boiling constituents that each contains. For example, fraction I, which was the least effective, had a residue above 225° C. of 8.1%; whereas fraction 5, the most effective, had a residue above 320° C. of 89.8%. Coal-tar creosote, with an efficiency between that of its lowest and its highest boiling fractions, had a residue above 320° C. of 25.8%. Now, it is not improbable that the high boiling, relatively non-volatile constituents tend to prevent the loss of lower boiling, poisonous substances. With such an assumption, it is easy to reconcile the apparently conflicting results of the service tests and the toxicity experiments.

Although the writers are convinced that the proportion of high boiling constituents in a creosote oil is a large factor in determining its value for marine work, they are also inclined to believe that other though more obscure factors may play an important part. It seems possible, for instance, that the tar acids and bases, which were found to be the most poisonous constituents of creosote, may be chemically combined in a creosote to form relatively non-poisonous compounds. Another and perhaps more reasonable assumption is that the high boiling acids (for example, naphthols) and bases (for example, quinolines), which are readily miscible with high boiling neutral creosote oils but only slightly soluble in sea water, will be found to have a very low coefficient of distribution between the neutral oils and the sea water in comparison with lower boiling acids (for example, phenol) and bases (for example, pyridine), which are much more soluble in sea water. The writers expect to test these assumptions experimentally in the near future.

Users of creosoted piling have been occasionally greatly puzzled on observing shipworms which were boring through heavily creosoted wood. The writers have themselves seen this; but on following the burrows back, have very frequently found that the point of beginning attack was at a spot which had received, if any only very superficial treatment. These observations furnished the basis for a series of service tests to determine whether shipworms would pass from untreated into treated wood; and, if so, whether the type of treatment would determine the extent of their attack.

Rectangular sticks of sap loblolly pine, about 3 x 3 x 36 in., finished on all sides, were treated at the Forest Products Laboratory with creosote I and the several fractions. A series of treatments was also made with special preparations as follows: (a) Benzol (90%); (b) resublimed naphthalene (25%) in gas oil (from Madison Gas & Electric Co.); (c) pure phenol (5%) in gas oil; (d) alphanaphthol (1%) in gas oil; (e) gas oil. After treatment the majority of the sticks were completely sheathed with untreated ½-in. sap pine boards secured from the same source as the treated wood. The sheathing was surfaced on the side in contact with the treated core, and was secured to the latter with brass screws. One specimen in each treatment was left unsheathed as a control. The purpose of the sheathing was merely to serve as bait for the microscopic free-swimming shipworms, and later as shelter for the borers until they should attain a size sufficient to render them easily observable. The main object of these experiments, however, was to study the reactions of the borers on reaching the treated cores.

The specimens were shipped to the U. S. Fisheries Station, Beaufort, N. C., and were installed in Beaufort Harbor in the middle of June, 1915—about five weeks after treatment. They were allowed to remain in the sea water for six months, and were then taken up and examined.

The results of these tests are illustrated in part in the accompanying group of views. The last shows that naphthalene, alphanaphthol, phenol and benzol, in the proportions in which they were present, were ineffective in these service tests. Perhaps the most striking point, however, about these tests was the fact that in each of the sheathed specimens treated with creosote or its fractionates the borers passed from the untreated sheathing into the cores; whereas the unsheathed controls shown in this group of views were unattacked.

The interpretation of these unexpected results lies in the peculiar life history of the shipworm. The latter invariably begins its attack on wood as a free-swimming larva, microscopic in size. At this time it is readily killed by traces of poisons which may slowly leach from the surface of unsheathed creosoted specimens. But when such a larva has once obtained a foothold in the wood, it undergoes a radical metamorphosis and grows with great rapidity, so that in two or three weeks it may attain a size thousands of times that of its larval state. This great increase in size is accompanied by a corresponding increase in resistance to creosote poisons; so that shipworms which by some chance have obtained a foothold may ultimately be enabled to burrow with apparent impunity through heavily treated wood.

Standard Specifications Best for Piling

The value of high boiling coal-tar creosote oils for this purpose may be considered as established, but further investigation is necessary to establish the value of specifying high boiling acids and bases in oils for marine work. A liberal content of acids and bases would do no harm, and if these results have practical significance, strongly indicate that they would increase the effectiveness of an oil.

The following specification was adopted at the 1917 convention of the American Wood Preservers' Association and provides a distillate oil containing more high boiling constituents than any previously adopted for use in pressure treating plants. While it was intended for treating paving blocks, it is also the best specification thus far adopted that could be used for piling. Such an oil need be used only in the most heavily infested waters. At least 22 lb. per cu.ft. should be injected.

The oil shall be a distillate of coal-gas tar or coke-oven tar. It shall comply with the following requirements:

1. It shall not contain more than 3% of water.
2. It shall not contain more than 0.5% of matter insoluble in benzol.
3. The specific gravity of the oil at 38°/15.5° C. shall be not less than 1.06.
4. The distillate, based on water-free oil, shall be within the following limits: Up to 210° C., not more than 5%; up to 235° C not more than 15 per cent.
5. The specific gravity of the fraction between 235° and 315° C. shall be not less than 1.03 at 38°/15.5° Centigrade.

The specific gravity of the fraction between 315° and 355° C. shall be not less than 1.10 at 38°/15.5° Centigrade.

6. The residue above 355° C., if it exceeds 10%, shall have a float-test of not more than 50 sec. at 70° Centigrade.
7. The oil shall yield not more than 2% coke residue.
8. The foregoing tests shall be made in accordance with the standard methods of the American Wood Preservers' Association.

The results of the recent studies may be summarized as follows:

1. The economic losses due to the activities of adult shipworms can never occur as long as treatments of wood for marine structures are able to prevent attack by the microscopic and apparently insignificant shipworm larvae.

2. Heavy treatments with a proper type of creosote will still prove inadequate as long as areas of superficially treated sapwood, heartwood, knots and so forth are left exposed for the lodgment of the shipworm larvae.

3. It appears that a proper creosote oil for marine work should contain a large proportion of constituents boiling above 320° C., as well as considerable amounts of high boiling tar acids and bases.

Water-Supply of Boston District Protected at Sources

The water-supply of Boston and the other cities and towns of the Metropolitan Water District is neither filtered nor chlorinated, but great care is taken to protect it from pollution.

Long before the district was established, Boston facilitated the diversion of the sewage of South Framingham and other towns from its water-supply by contributing toward the cost of sewage-treatment works located in other drainage areas. When the Metropolitan Water District built its works it constructed filter beds to treat the sewage of Clinton, preparing it for discharge into the Nashua River below Wachusett impounding dam.

State legislation provides that the Clinton works be operated by the Metropolitan Water District until the sewage of the town "shall have outgrown the normal capacity of the south branch of the Nashua River to properly dispose thereof," after which the town must take possession of the works at a price to be agreed upon mutually and operate them. The last annual report of the Metropolitan Water and Sewerage Board states that "the time is near at hand, if it has not already been reached, when this provision of the statute should become operative."

The report also states that the board is operating a number of filter beds to treat the waters of streams flowing through thickly settled sections of the various water-gathering grounds in its charge. These waters include Marlborough Brook and tributaries in Marlborough, Piegan Brook in Natick, a stream flowing through built-up parts of Sterling, as well as smaller "filter beds which receive the drainage from a few houses near Sterling Junction, the Worcester Training School at West Boylston, and from the swimming pool at Southborough." The effluent from two of the filter beds was treated with calcium hypochlorite. Hypochlorite was also applied for a few days to the overflow from the intercepting reservoir at the Piegan Brook filter beds, on account of the fact that diluted sewage overflowing from the Marlborough main sewer was then being discharged into this reservoir.

Cast-in-Place Reinforced-Gypsum Roof Slabs on Paper-Mill Buildings

New Methods Developed for Handling and Mixing the Material, for Form Construction and for Order of Procedure—Gypsum Used Without Sand or Stone

THE GYPSUM PASTE WAS POURED INTO THE FORM AS SOON AS MIXED AND WHEN FULL THE FORM WAS SCREEDED OFF WITHOUT DELAY

A ROOF SLAB of reinforced gypsum cast in place has just been completed on a new beater house of the Scott Paper Co. at Chester, Penn. It is the second of two such roofs that the company now has. The first was constructed last winter, in cold February weather, over a paper-machine house. This is a flat roof, 47 x 180 ft., sloping ¾ in. per ft., while the beater-house roof, 45 x 157 ft., is a ¼ pitch roof with monitor, sloping 6-in. per ft.

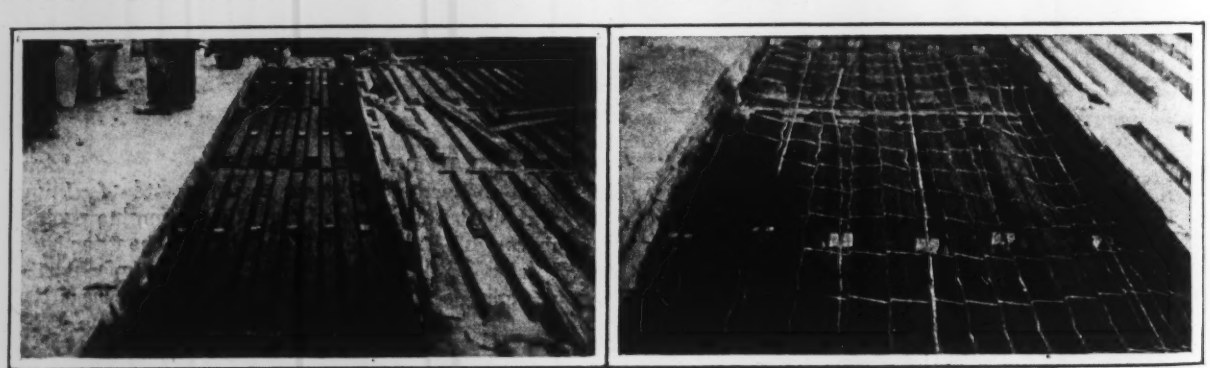
Both buildings have reinforced-concrete frame, steel roof trusses, steel purlins spaced 6 to 6½ ft., and were intended to be roofed with reinforced-concrete slabs across the purlins. But during erection the officials of the paper company began to fear trouble with condensation on the under surface of the roof slabs, and in conjunction with the architect, George F. Hardy, of New York, they looked around for a roof material likely to be free from such objection. Gypsum was finally settled on as the most desirable. The contractor, the Cummings Structural Concrete Co., of Pittsburgh, agreed to undertake cast-in-place construction instead of laying premolded gypsum blocks.

New methods had to be worked out for handling and mixing the material, for form construction, and for order of procedure. Experience elsewhere in casting gypsum blocks was drawn upon, and early trouble with forms sticking and having to be chopped out—because of using rough lumber and giving the vertical surfaces of the T-beams no draft—soon taught the need for special care.

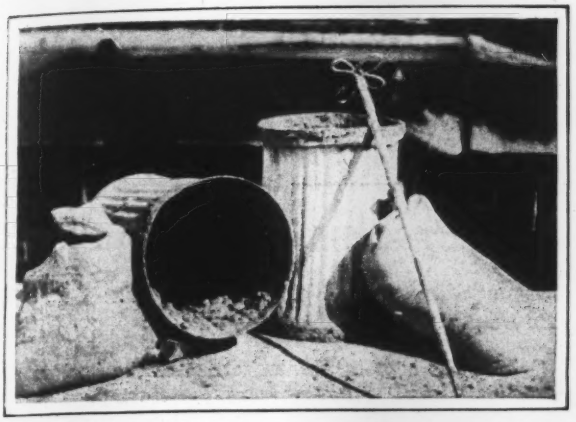
The contract for the gypsum roof was taken at the price previously accepted for the reinforced-concrete roof. Whether or not the contractor lost money under this arrangement is not known. The design was made by ordinary reinforced-concrete beam formulas, but with lower compression—300 lb. per sq.in.—while the steel tension was held at 16,000 lb. per sq.in. The T-beam stems are a trifle over 2-in. wide and are spaced 6 in. center to center.

The procedure is briefly described below, but the accompanying photographs of the work in progress bring out most of the essential points needed for a comprehension of the process.

The gypsum was used neat—as a water paste without sand or stone. It was mixed to the consistency of a batter or thin paste. This is best illustrated by the views showing the paste being poured out of the mixing can into the form.



A 3-FOOT STRIP ACROSS THE ROOF WAS BULKHEADED OFF, THE FORMS CLEANSED AND OILED, ROD REINFORCING PLACED ON PLASTER BLOCKS IN THE T-BEAM STEMS AND WIRE MESH LAID OVER



THE MIXING IMPLEMENTS: AN ASH CAN AND A DASHER

A bag of gypsum was emptied into the can two-thirds full of water, and the dasher used quickly to make a smooth batter—no sand or stone

The mixing equipment consisted of a metal ash can and a stirrer or dasher, as illustrated. The can was filled two-thirds full of water, a bag of gypsum was poured in, and the dasher was worked quickly to get a uniform paste. Then the mixture was poured into the form and the surface screeded off without delay, for within 15 min. the gypsum set so hard that forms could be stripped if desired and men could walk on the slab.

The forms consisted of a tight floor of matched boards, and lengths of dressed 2 x 4 stock nailed on flatwise, 6 in. on centers to core out the spaces between the T-beam stems. These cores were dressed to ½-in. draft on sides and ends. The form was shellacked and sandpapered, like a foundry pattern, and before use was brushed with a clear oil (press oil), using a long-handled whitewash brush as shown in one of the views.

THE FORMS, BUILT OF PLANED LUMBER AND HEAVILY DRAFTED, WERE SHELLACKED AND RUBBED DOWN, AND GOT A COAT OF OIL BEFORE EACH USE. THE OIL WAS APPLIED WITH A WHITEWASH BRUSH

The roof was placed in strips 3-ft. wide running across the building, the same direction as the T-beams. The open side of the strip was closed off by a bulkhead plank whose width was just the thickness of the slab, so that a screed moved along the bulkhead would true the gypsum to the proper surface. In each T-beam stem was laid a ¼-in. rod, supported on little precast blocks of gypsum; these rods formed the sole reinforcement of the roof. Over the tops of the T-stems was laid a 3-ft. strip of wire mesh as bonding steel to restrain the expansion of the gypsum. The form was then ready for pouring.

Pouring was done in one continuous operation for the 3-ft. strip clear across the building, about 50 ft. In smooth operation it took less than an hour to cast the strip, but during this time the first part of the strip had set hard before the last part was poured.

A sufficient number of bags of gypsum for one strip was brought up by hoist from the box-car in which it was received on the job, and the bags were set up in a row along the edge of the strip about to be cast, standing on the strip finished last. They were then untied, making all ready for quick work. Mixing, pouring and screeding proceeded in regular order until the strip was completed.

BAGS OF GYPSUM SET IN ROW ALONG STRIP OF ROOF TO BE POURED, AND THEN ALL UNTIED

It was found necessary to use the gypsum fresh. If allowed to stand some weeks before use its setting power was reduced considerably.

The machine-house roof was poured in the last week of February, 1917, in very cold weather. Snow had to be scraped off the roof at times. The low temperature did not affect the setting of the gypsum, however.

Construction of the beater-house roof, during the past month, went on in the same way as just described, except for complications introduced by the steep pitch. Stepped platforms had to be set on the roof to give a working floor, and the soft gypsum paste had to be held from flowing down. For the latter purpose, top forms were not successful; the thin paste came up like water through any crevice or hole. But by holding a bulk-

THE GYPSUM ROOF SEEN FROM BELOW

head board on top of the screeded surface of the slab just poured, and pouring the paste from a pail against the face of this board, the gypsum was held and could be spread out upward along the roof the moment it thickened enough to hold shape. Pouring a strip was begun at the gutter and proceeded up to the ridge, this being the same as was done in the case of the flat-pitch roof.

Each of the two roofs required about ten days for the gypsum work. As already stated, forms could be taken down early, and only four sets—3-ft. strips—of form were provided.

Conclusions on Activated-Sludge Process at Milwaukee

T. Chalkley Hatton Discusses Many Features of Sewage-Treatment Work—Believes That with a Large Plant Sludge Can Be Disposed of at a Profit

IN a paper presented before the annual convention of the American Public Health Association last week in Washington, T. Chalkley Hatton, chief engineer, Sewerage Commission, Milwaukee, Wis., presented a résumé of conclusions on the activated-sludge process of sewage treatment, based on investigations made at the Milwaukee sewage-testing station. The essential features of the process are the passage of sewage through aërating tanks containing a certain proportion of activated sludge and the further passage of the sewage thus treated through sedimentation tanks. The sludge removed from the latter remains for final disposal, as in various other methods, but its peculiar characteristics demand special treatment. The paper, in slightly condensed form, follows: In this as in all other methods of sewage treatment, the character of the effluent required is one of the first questions to decide, for upon it depend the size of plant and the air required to operate it.

If the removal of the matters in suspension and the production of a clear effluent are all that is required, less aërating tank capacity and less power should be provided; whereas, if the effluent must be not only clear but well nitrified, the sewage must be given a longer period of contact with the air and sludge and a greater volume of air per gallon of sewage treated must be used.

In an aërating tank having 15 ft. effective depth of liquor, 98% removal of suspended matters can be effected with 0.5 cu.ft. of air per gal. of sewage treated applied for 1 hour, but if nitrates are to be produced in the effluent the same sewage will require from 0.75 to 1.1 cu.ft. of air per gal. applied from 4 to 6 hours.

The reason is found in the fact that the agitation of the liquor by the air separates the solids and colloidal matters very rapidly, but it takes time for the bacteria contained in the activated sludge to convert the ammonias into nitrites and these in turn into nitrates.

Preliminary Processes Desirable

Should the sewage to be treated be combined with storm water, grit chambers should be installed, of such a design as effectually to exclude all grit from the aërating tanks.

The sewage from an industrial community, collected by either a separate or a combined system of sewers, should be fine-screened before passing into the aërating tanks. This positive statement is the result of the author's observation, covering two years, of the operation of the activated-sludge process under varied conditions at Milwaukee.

Grit in the aërating tanks settles to the bottom and rests upon the air diffuser plates, interfering with their efficiency. All industrial sewage carries quantities of waste, fleshlings, pieces of leather, packing-house wastes, large pieces of paper and textiles of many kinds, lime and hair. In the aërating tanks these things form masses of great specific gravity, settle upon the diffuser plates and interfere with their efficiency. If they are carried over to the sedimentation tanks they frequently stop up the sludge draw-off pipes and valves, and thus disturb the continuous operation of the plant. Besides, the decomposition of the organic matter contained in these articles requires large quantities of air, which is a more expensive medium than is required in other forms of sludge reduction. We found at Milwaukee that we could save from 15% to 20% of air when treating sewage passing a 20-mesh screen, as compared with the same sewage passing a 1-in. grid screen.

Where a purely domestic sewage is to be treated by the activated-sludge process, the author is not so sure that fine screening is necessary. He believes that a $\frac{3}{16}$-in. slotted screen is fine enough for any sewage.

Preliminary sedimentation, in lieu of fine screening, is not applicable to the activated-sludge process if the sludge is to be disposed of finally as fertilizer. The sludge from such a tank contains very little ammonia, is hard to handle and mix with activated sludge, and when mixed adds to its weight without adding correspondingly to its value; whereas, fine screenings contain almost as much available ammonia as the activated sludge, can be easily mixed with it in the dryer, and increase the value of the mixture to a proportionate extent.

Type of Aërating Tank

After the period of retention in the aërating tank and the volume of liquor to be treated are decided, the tank should be so proportioned as to give the greatest length of flow possible without wasteful use of piping and concrete. Our tanks in Milwaukee are to be 350 ft. long and 22 ft. wide, the liquor being admitted at one end and removed from the other.

As the piping system of the activated-sludge process is an expensive feature, due attention should be paid to it in the design. All valves should be so placed as to be easily reached, and all air piping should be of such type as to preclude inside corrosion. Iron rust gets into the pores of the air diffusers and reduces their efficiency. Therefore, cast-, galvanized-, or Sherardized-iron pipe, or lead, should be used to carry air.

In cold climates all air pipes must be made frost-

proof to prevent hoarfrost from accumulating on the inside and increasing the frictional resistance to the air. Frost-proofing can be effected by placing the air pipes a few feet under the surface of the liquor in the aërating tanks.

The bottom of aërating tanks should be of saw-tooth, or similar form, with slopes from 1 to 1 to 1 to 1.5, with the air diffusers placed in the gutters. The object is to allow upon the bottom no flat places upon which sludge could rest and become septic.

The air diffusers may be placed in cast-iron or concrete containers—preferably the latter, because they cost less and do not corrode. If cast-iron containers are used, they should receive a good coat of pitch while hot, care being taken to place the diffusers in the containers in such manner as to secure air-tight joints and permit removal and replacement without damage.

Milwaukee Conclusions on Sedmentation

Sedimentation has received greater study at the Milwaukee testing station than any other feature of the process. It will perhaps be sufficient to state the general conclusions borne out by these experiments.

The running-through velocity should not exceed 3 ft. horizontal per minute.

The detention period may be from 30 to 50 min., according to character of sewage treated.

Vertical-horizontal flow is more efficient than vertical or horizontal.

The effluent must be removed with the least velocity possible and over continuous rather than V-shaped weirs. The latter create cross-currents just where they are most objectionable. Cross-currents must be avoided so far as possible.

Baffled Cross Flow Required

The influent must be introduced back of a baffle at least 4 ft. below surface of liquor in tank.

The flow should be across the narrow section of the tank. Too long a path of flow tends to pick up the lighter particles of sludge and carry them over with the effluent.

A baffle should be placed back of the effluent weir and extend a few inches below the liquor surface. This is to prevent the fats, match sticks and other light substances, which float upon the surface of the liquor, from passing out with the effluent.

The depth of the tank is not important, except that it shall be sufficient to allow capacity for the settled sludge to be drawn off without abnormally increasing the under-currents near the level of the bottom of the influent baffle due to the suction of sludge passing from the tank.

An area of 1 sq.ft. for each 1600 gal. of well aërated sewage should be provided. The less the aëration the greater the area required.

The tanks may be either hopper or flat bottom, as desired, and the sewage may be removed by air lifts or hydrostatic pressure. If hopper bottoms are used the slopes must be from 1 to 2 to 1 to 3 to keep the sludge moving toward the draw-off pipe. If the flat bottom is used some apparatus must be provided to remove to a draw-off pipe the sludge settling on the bottom. This may be done by a Dorr thickener or similar device, or by a squeegee mechanically operated from the top of the tank. In the Milwaukee Station the last two mentioned devices have been tried out with satisfactory results. They insure a clean tank, thicker sludge and less tank depth. Returning thicker sludge to the aërating tanks means reduction of air. In localities where deep tanks would add greatly to expense of construction the mechanical devices above mentioned probably would be advisable.

Several types of air diffusers have been tried at Milwaukee.

Tile are not sufficiently uniform in porosity.

Basswood blocks cut cross-grain ½ in. thick, 2 to 3 in. wide and 4 to 6 in. long, give excellent diffusion when first operated. If not treated with a preservative the surface exposed to the sewage deteriorates within a short time through fungous growths. If treated, the diffusion efficiency is diminished. Wood must be saturated constantly in order to keep it in place. If for any reason an aërating tank should be thrown out of commission long enough to allow the wood to dry out, the blocks would pop out of place when the tank was put into operation again. Therefore wood is not applicable to the process.

Perforated pipes give good air diffusion as long as they are kept in constant service and are of such material as to preclude corrosion. The perforations necessarily must be very small and close together. When they are made through galvanized-iron pipe corrosion soon occurs, which stops up the perforations. When the air is taken off the pipes with liquor in the tank, the latter is drawn into the pipes through the perforations by back suction, and when air is returned to the pipes the solids in the liquor which have entered the pipes are forced into the perforations and stop them up. Our experience and that of most other experimenters indicates that perforated pipes as air diffusers cannot be depended upon.

Filtros plates, made by the General Filtration Co., Rochester, N. Y., are porous plates 1½ in. thick, made up of graded sand and burned in kilns under high temperatures. They can be made of any degree of porosity required, are stable in character and are, by all means, the most satisfactory air diffusers we have used at Milwaukee.

Ratio of Air Diffuser and Tank Surface

Ratios of 1 to 4 to 1 to 10 have been used in the United States and England. The latter inclines towards the greater ratios. It is the author's opinion that the economical ratio depends largely upon the type of aërating tank used and the character of effluent required.

In a short flowing-through length a ratio of 1 to 4 or 1 to 5 would prove more efficient, thus decreasing the tendency of short-circuiting the passing liquor; whereas in long flowing-through tanks a greater ratio could well be used, because the law of averages is thus better utilized.

The higher standard effluent required the smaller the ratio, for the reasons stated above. The author has determined to use a ratio of 1 to 6 in the Milwaukee plant, where the tanks are 350 ft. long and must produce a high standard effluent.

This factor depends largely upon the character of sewage to be treated and effluent to be produced.

A mixture of domestic and industrial sewage can be well clarified—that is, to contain not more than 5% of the suspended solids in the original sewage—in 1 hour's aëration by using from 0.5 to 0.9 cu.ft. of free air per gal. of sewage treated. To maintain this clarification, however, it is necessary to aërate further the sludge removed from and returned to the aërating tanks. This procedure, however, saves air, because the sludge aërated is only ⅓ to ½ of the total volume of sewage treated.

To produce from the kind of sewage described an effluent containing nitrates and 4 to 6 p.p.m. of dissolved oxygen, with a reduction of bacteria from 95 to 98% requires from 4 to 6 in. aëration. After such period of aëration there seems to be little or no advantage from re-aërating the sludge, probably because it is maintained in prime and active condition by the period of aëration above stated.

Period of Sedimentation

The period of sedimentation is connected closely with the period of aëration, assuming the sewage treated to be of similar character. A short period of aëration requires a longer period of sedimentation. Well activated or well aërated sludge flocs very rapidly and settles out of the liquor at the rate of 1 in. vertically per minute, whereas poorly aërated sludge flocs slowly; in fact, the finer particles seem incapable of floccing. The principal factor seems to be the area provided, as has already been mentioned. From 30 to 50 min. are sufficient to clarify the sewage, providing the sludge is removed from the sedimentation tank as rapidly as it settles.

Volume of Air Required

Theoretically, it would cost the same to supply an aërating tank 15 ft. deep with 1 cu.ft. of air under 6.5 lb. pressure per gal. of sewage treated as to supply a tank 10 ft. deep with 1½ cu.ft. of air under 4.34 lb. pressure.

If this ratio of air is equally effective in the depths mentioned, the air supply to the 15-ft. tank would be cheaper because the frictional losses through the diffusers and air mains would be about the same in a tank of either depth. If this theory were exended, the deeper the aërating tank the cheaper the air supply. But the less the depth of tank the better the circulation, the smaller the air bubbles and the greater the saturation. Again, it should be noted that the deeper the tanks the greater the volume of sewage treated per acre of disposal plant. This means less concrete construction, air piping, valves, fittings, influent, effluent, and sludge carriers and, last but not least, less area of tank bottom containing the air diffusers. Under average conditions, aërating tanks 15 ft. deep would prove cheaper probably than tanks 10 ft. deep.

The author believes that the Milwaukee sewage can be treated successfully to produce an effluent showing 90% removal of bacteria, 95% removal of suspended matter and 72 hour stability, by using 1.5 cu.ft. of air per gallon of fine-screened sewage in a 10-ft. deep tank, and 1.1 cu.ft. of air per gallon in a 15-ft. deep tank, using from 15 to 25% of activated sludge in the aërating tank; screens to have from ⅛- to $\frac{3}{16}$-in. slots.

About 20% of well activated sludge is all that is required for satisfactory treatment. This percentage is measured in a beaker after ½ hour's settlement, after which the settled sludge contains about 99% of moisture.

Up to 1917 our computations to determine the weight of dried sludge produced from the process had been made according to the formula suggested by George W. Fuller, "Sewage Disposal," p. 23. Finding several discrepancies, we determined to make experiments to ascertain the reduction in activated sludge. It was found that 1640 lb. of dried fertilizer, containing 10% moisture, were produced, whereas by Fuller's formula we should have obtained about 2034 pounds.

In our final plant at Milwaukee we are providing means to produce from each 1,000,000 gal. of raw sewage treated 55,565 gal. of sludge containing 99.5% moisture, 10,250 gal. containing 98% moisture, 8305 lb. of pressed sludge cake containing 76% of moisture, and 2076 lb. of dried sludge containing 10% moisture.

Removing Sludge from Sedimentation Tanks

Several methods have been tried at Milwaukee for removing the sludge from the sedimentation tanks. Where hopper-bottom sedimentation tanks have been used the air lift has been utilized principally. This method has two disadvantages—excessive cost of pumping and producing sludge of high moisture content. It has the advantage of easy control and increased aëration of sludge.

Removing the sludge by means of the hydrostatic head has the advantage of producing a much thicker sludge and a more uniform flow. This last is an important factor in that it prevents to some extent the accumulation of sludge upon the side slopes of the tank, and thus less dissolved oxygen is absorbed in the sedimentation tank. By proper arrangement of valves the sludge draw-off can be regulated satisfactorily, but care must be taken to avoid placing a valve in the draw-off pipe, as it tends to cause complete stoppage of the sludge flow. When possible, a sluice gate should be placed at the outlet of the draw-off pipe.

In every hopper-type bottom used by the author there has been more or less sludge accumulation upon the side slopes of the tank. This sludge becomes septic and absorbs the dissolved oxygen, thus producing a lower grade effluent from the sedimentation tank.

To overcome this tendency flat bottom tanks have been used and squeegees introduced to remove the sludge to a central blow-off pipe. Two types of apparatus have been used with success. The first is what is known as the Dorr thickener, and consists of two or more horizontal arms to which leather scrapers are attached and which revolve around the bottom of the tank, scraping the sludge to a central pipe. These arms are attached to a vertical shaft supported in the center of the tank and actuated by some power device located at the surface. From long continued tests we have found that the maximum allowable speed of the squeegee arms is about 12 ft. per minute. We have been able to precipitate the sludge successfully by this process at the rate of 1500 gal. of sewage per sq.ft. of tank.

Another device satisfactorily demonstrated has been a squeegee moving over the bottom of a rectangular tank. The squeegee is attached to a slotted horizontal pipe,

which is in turn attached to a vertical pipe fastened to a car running on tracks built upon the top walls of the tank. This apparatus acts in the same way as a vacuum cleaner, the air lift being used to remove the sludge and the car being run by an independent motor with compressor or otherwise, as is learned to be most convenient.

This apparatus has the advantage of removing the sludge in a denser condition than any other method we have used; 98% of moisture is about the average. In construction and operation it is more expensive than the Dorr thickener.

Either of these last two methods results in lower cost of sedimentation tanks, shallower tanks being required than in the case of tanks of the hopper-type bottom.

The denser the sludge removed from the sedimentation tanks the less area required for both aëration and sedimentation, because with dense sludge returned to the aërating tanks much less liquor has to pass through these tanks to maintain the proper percentage of sludge.

It is therefore the author's opinion that the removal of the sludge by mechanical means will reduce largely the first cost of plant, and will produce a much more satisfactory and uniform effluent.

Dewatering Sludge

The dewatering of sludge may be effected satisfactorily in several ways, depending upon its final disposition. Should the plant be small and local temperature above 50° F., the wet sludge can be dewatered to 75% moisture in a few days of good weather upon beds of stone and sand, in the same way that sludge produced from Imhoff tanks is dewatered. In colder climates, these drainage beds may be protected by glass buildings similar to hothouses. Sludge containing 75% moisture or less can be kept under cover without creating an unpleasant odor. During the proper season it can be spread over tillable ground in lieu of manure, in about the same quantity, and will have greater fertilizing value.

It can be dewatered to 75% water by means of presses of different type, after which the cake can be stored under cover and spread, as said before, upon the ground during the proper season; or it can be pressed, dried and ground to produce a low-grade fertilizer sought for in any market in this country.

The following remarks apply particularly to plants of considerable size producing sufficient sludge to warrant the expense of reducing it to a commercial fertilizer basis.

The sludge from a hopper-bottom type of sedimentation tanks contains from 99 to 99.5% of water. If this is allowed to settle in a tank for 5 or 6 hours, the water content can be reduced to 96%, and the volume to one-eighth. This resultant sludge can be dewatered, by any one of at least three kinds of press, to 75 to 80% of moisture and to one fifty-seventh of its original weight. It can be dewatered further by drying in any one of a number of standard kinds of dryers, to 10% moisture and about one two-hundred-and-twenty-third of its original weight.

After drying it must be run through a grinder, of any standard type, to reduce it to sizes applicable to an agricultural seeding machine.

Careful inquiries have been made of manufacturers and dealers in fertilizers as to the market for such a fertilizer and the probable financial return therefrom. We believe we are warranted in concluding that with a plant of the size necessary for the City of Milwaukee the sludge produced by the activated-sludge process can be reduced and disposed of at a profit.

The 6 x 9-ft. Berrigan press, made by H. R. Worthington, Harrison, N. J., can dewater 96% sludge to 76% sludge at the rate of about 7 tons of pressed cake per 24 hours.

The 60-plate 3 x 3-ft. press made by the Simplex Ejector Co., Chicago, Ill., can dewater 96% sludge to 80% sludge at the rate of 7 to 8 tons of pressed cake per day.

The 5 x 40-ft. Buckeye direct heat-dryer made by the Buckeye Dryer Co. of London, Ohio, can dewater 76% sludge to 10% sludge at the rate of 27 tons of dry material per 24 hours by using 1 lb. of combustible to 10 lb. of water evaporated.

The indirect steam dryer of the Smith type can also dewater the sludge successfully, but at what maximum rate we are unable to state, as we never ran it at its maximum.

The one important and unsolved question in the cost of pressing is the cost of the filter cloths or bags, and this cannot be solved except after a year or more of continuous operation. We are basing our estimates on the experience at Worcester, Mass., where Matthew Gault, superintendent of sewers, states in his annual report that it requires 2.2 yd. of 40-in. wide No. 3 duck per ton of dry sludge produced.

Cost and Value of Dried Sludge

The cost of pressing the sludge is $4.82 per dry ton. This cost includes interest charges at 4½%, depreciation of 2% to 6%, according to character of structure or apparatus, repairs and renewals, filter cloths at $1 per dry ton of sludge, power, labor and all other known expenses.

The cost of drying is $3.93 per dry ton, which includes all charges as above named for pressing except that 10% depreciation for dryers is estimated, $3.75 per short ton of coal, $0.00424 per kw.-hr. for power, 8 lb. of water evaporated from 1 lb. of combustible from sludge cake containing 76% moisture.

A typical analysis of dried sludge, as shown on page 49 of the third annual report of the sewerage commission of the City of Milwaukee, shows 5.1% of nitrogen as $N.H_3$, 5.3% fat, 0.5 soluble phosphoric acid and 0.25 potash. In normal times the nitrogen is worth $2.50 per unit. At the present time it finds a ready market at $3.60. Basing the value of the sludge produced upon the lower price per unit, we find our sludge would be worth $12.50 per dry ton, which represents a clear profit of $3.75 per ton.

In the complete report of Pearse and Richardson to the engineering committee of the sanitary district of Chicago and the committee representing the stockyards' interests, dated Apr. 16, 1917, it is estimated that sludge pressing will cost $5.72 per dry ton and drying $2.45 per dry ton, or a total of $8.17 per dry ton.

In considering these costs the present high war prices must not be overlooked. These affect also the entire

disposal plant for the City of Milwaukee, plans and estimates of which have just been submitted to the sewerage commission. The estimated cost of this plant for treating an average dry-weather flow of 85,000,000 gal. a day is $4,307,000, whereas 18 months ago the same plant could have been built for $3,000,000.

Estimating that one ton of dry sludge can be obtained from 1,000,000 gal. of raw sewage treated, and an average daily dry-weather flow of 85,000,000 gal., the net cost of disposing of Milwaukee's sewage is estimated as $9.64 per 1,000,000 gal., of which $4.89 is chargeable to overheads, and $4.75 to operation, renewals and repairs. The 85,000,000 gal. of sewage per day is expected to be produced from a population of 589,000, and the net cost of operation, including overhead charges and maintenance, is 53c. per capita.

Elimination of Odors

There is no offensive odor connected with the activated-sludge process of sewage treatment, but considerable odor may attend improper methods of sludge reduction. Partially dewatered sludge, if exposed to the sun for a few hours, gives off a highly objectionable odor of sulphuretted hydrogen. This odor lasts for a short time only, or until a dry covering is formed. Sludge placed under cover and not exposed to sun or wind gives off little odor.

When the sludge is dried through a direct heat dryer, a very offensive odor is thrown off with the hot gases of combustion. To overcome this, the gases must be run through a dust box, thence through a condenser, and the insoluble gases escaping from the latter should be discharged into a furnace immediately under the fire grate.

Flies, insects and worms do not infest the treatment plant, even during the early fall when they are so prevalent in nearly all other types of disposal plants.

Conclusion

The foregoing statements and conclusions have been made as the result of observations and studies of the operation of the sewage testing station at Milwaukee during three years; the last half of the study has been almost exclusively confined to the activated-sludge process.

The only process known to the author which can produce an effluent comparable with that from percolating filters is the activated-sludge process, which, when developed to the extent possible and very probable within the next decade, will doubtless supercede the filters. There are many advantages in this new process which must be considered, among which are small area, lower first cost, and final disposition of the troublesome sludge.

As compared with percolating filters treating a maximum rate of 3,000,000 gal. per acre under favorable climatic conditions, the activated-sludge process can treat 10,000,000 gal. per acre under the most unfavorable climatic conditions.

The first cost of construction is higher for the percolating filters than for the activated-sludge process, and little difference is expected in the cost of operation.

Metcalf and Eddy in Volume III, "American Sewerage Practice," give the following figures as to the cost of construction and operation of several important percolating filter plants: At Gloversville, N. Y., the cost was $58,455 per 1,000,000 gal., exclusive of roofing. Operating cost in 1914 was $5.92 per 1,000,000 gal. At Fitchburg, Mass., the cost was $59,650 per million with operating cost when treating about 2½ millions about $12.00 per million.

The average cost of nine of the most modern plants in the United States is given as $47,000 per million gallons. (These costs are exclusive of engineering.) E. J. Fort, of Brooklyn, estimates the cost of overheads and operation for a plant treating 30 million gal. will be $9.50 per million gal., exclusive of the final disposition of sludge. Mr. Ulrich, city engineer of Reading, Penn., gives the operating cost of the Reading plant as $9.13 per million in 1912.

The Milwaukee plant, as designed, is estimated to cost $44,000 per million, exclusive of engineering and pumping, and $4.75 per million gal. operating cost. This first cost embraces prices for labor and material which did not prevail when the percolating filters above referred to were built.

Mr. E. E. Sands, city engineer of Houston, Tex., has just completed an activated-sludge plant (exclusive of sludge disposal) to treat 12 million gal. at a cost of about $24,000 per million, and expects to install the sludge disposal features for $40,000, the balance of his appropriation.

The high nitrogen content in the sludge produced from the activated-sludge process warrants the expense necessary to reduce it to a fertilizer basis, and thus the sludge problem is solved without nuisance.

The absence of odors, flies and other insects is no small advantage. Freedom from odors frequently enables the engineer to eliminate long expensive outfall sewers. The small loss of head through the process frequently obviates pumping, as is so often required in the percolating filter process.

Throughout many discussions by engineers of this new process the cost of power has been one of the stumbling blocks. In a small plant treating less than five million gal. per day the cost of producing the power might prove too expensive, but where larger plants are under consideration power can be produced easily for less than 1c. per horsepower-hour. Such a cost will place the cost of operating the process upon an equality with that of the percolating filters.

However, local conditions can determine best which of the two processes should be installed, but the author contends that such determination should be made only after a thorough study of the merits of the two processes, and not from the point of view that one process has been operated successfully in many places, whereas the other is still more or less in an experimental stage. If this attitude were adhered to in the industrial field, very little progress indeed would be made.

Drifting Sand is a Public Nuisance

Controversies over drifting sand that has obliterated new street work in the western part of San Francisco will be stopped by an ordinance passed by the Board of Supervisors, authorizing the Board of Public Works to remove the sand and assess the cost against the property from which it was allowed to drift.

Steps in Turbine-Runner Design That Engineers Should Know

After a Few Controlling Dimensions Have Been Computed It Is Possible To Shape Up Waterwheel Runners in a General Way and Form Independent Judgment of the Builder's Design

By Walter C. Pomeroy
Ann Arbor, Mich.

THE DETAILED design of hydraulic turbines is a highly specialized engineering effort outside the daily duties even of most hydraulic engineers, but it is widely recognized that any engineer desiring to form an independent judgment of a particular turbine must have a good general knowledge of turbine construction and some intelligent conception of the type characteristics of different runners. Moreover, he must have a better knowledge of the actual steps in runner designing than most persons have realized.

It is aimed in the following paragraphs to give a general idea of the processes of laying out a turbine runner and, inferentially at least, to show how a design may be scrutinized. No attempt has been made to have the studies broad enough to be of value to a turbine designer.

To date, promoters place all reliance on Holyoke data and the turbine builder's reputation. These are only half-way measures. If, as usual, there are modifications in the larger runner over the model, the promoter has no way of checking the effect of the changes on performance. There should be someone on the promoter's staff who can form independent judgment of the turbine before it is built, installed and tested.

General Problems of Design

The problems met in the design of turbine runners are of two quite distinct classes. Solution of the one variety involves a knowledge of the laws of hydrodynamics and the scientific application of experimental test data. Solutions of the second class are almost entirely a matter of graphical construction. This article is limited to the latter. Trial methods are much in evidence, and the reader should understand thoroughly that in designing a turbine runner he may have to use his eraser quite as energetically as he does his pencil. Each step seems to depend on the one ahead of it; the design is in effect the systematic weaving together of several problems separately indeterminate.

A few generally misunderstood ideas should be mentioned: The theoretical attack does not insure a good runner. There are no definite laws governing the principal dimensions of the runner nor their exact relation to speed, capacity or efficiency. No designer can state the efficiency of a new design without previous tests of very similar models. Runners of distinctly different appearance may show similar performance and those of apparent similarity disclose quite different characteristics. This would seem to indicate that no designer has been able to unite all the good features in one design or steer clear of all the bad.

For the present studies we will state the problem thus: Required to design a runner to deliver 3 sec.-ft. and to run at 75 r.p.m. under 1-ft. head; the principal dimensions are:

$D_1 = 16$ in. (rated diameter, at center of entrance edge);
$B = 4$ in. (height of gate);
$D_2 = 16$ in. (diameter of discharge-edge rim circle); and tangent to travel circle in direction of
$\beta_1 = 90°$ (angle between bucket vane at entrance flow line).

Drawing the Flow Lines

The rim and crown surface of the runner are the two rotating surfaces at each extreme of the bucket vanes and are shown in the elevation view (Fig. 1) by the lines in which they cut the plane of the paper. Consider the space between the rim and upper crown surfaces free from any bucket vanes: This space should have no sudden change in volume, a fact which aids us in determining the exact form of the generating lines of these surfaces. By use of the proposition of Pappus we divide this space into smaller equal-volume sections. This is not accomplished by the first stroke, as the niveau lines AA', BB', CC' must be taken at right angles to the flow lines, which are as yet undetermined. However, with a careful eye these can be worked into place with the proper relation to each other very closely and then corrected exactly. For equal-volume sections we have

$$2\pi r_1 b_1 = 2\pi r_2 b_2 = 2\pi r_3 b_3 = 2\pi r_4 b_4$$

with b always measured at right angles to the flow lines.

Assuming continuity of flow, the generating lines I I, II II, III III, IV IV and V V of the boundary surfaces of these smaller volumes become stream lines, or directions of flow; the niveau lines AA', BB' and CC' are the generating lines of surfaces of constant velocity. The exactness of these lines is not of serious consequence, especially in this type of runner.

Entrance and Discharge Edges

The elevation view of the entrance and discharge edges (see Fig. 2) cannot be definitely determined at once, but must be assumed and later modified to suit conditions met in the development of the plan view. The two edges of the bucket vane do not lie in the same radial plane, and either one may not even lie in a single plane. However, we shall tentatively place our discharge edge in one radial plane, that of the paper, and revolve the entrance edge into the same plane. The discharge and entrance edges are assumed as shown in Fig. 2. The use of drawings of runners of known results is of great help at this point, although there is a very wide choice—some designers using the so-called

"short bucket" and others employing a very deep "spoon" on the discharge edge, as shown dotted in Fig. 2. Good runners have been produced in both cases.

After assuming the discharge and entrance edges, we compute the equivalent area of discharge and entrance at right angles to the flow. This discharge and entrance area of each small turbine section is $2\pi r_1 b_1$, $2\pi r_2 b_2$, etc., respectively, with no allowance made for bucket-vane thickness (see table, Fig. 2).

In drawing the velocity diagrams, which is the next step, we consider first the peripheral velocity—which

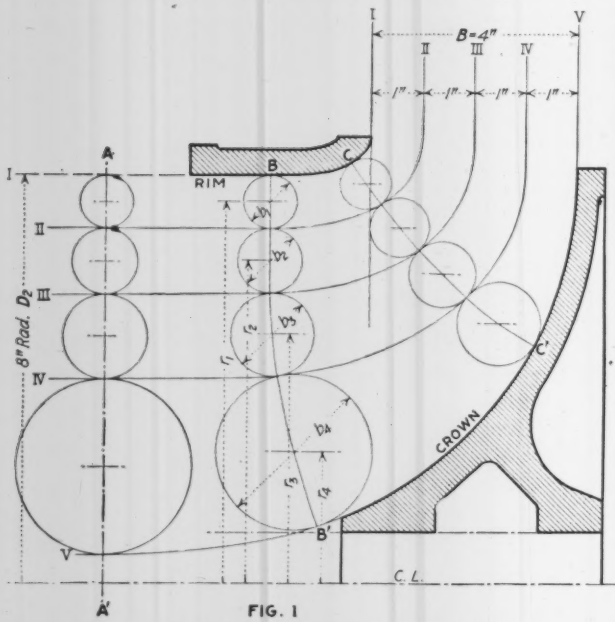


FIG. 1

DIAGRAM FOR DRAWING FLOW LINES

DISCHARGE EDGE

Sect.	Rad.	b	ft²	C_2 from Diag.	Q'' c.f.s.
1	7.28"	1.06"	0.346	2.31/Sec.	0.795
2	6.03"	1.26"	0.346+	2.25 "	0.780
3	4.87"	1.64"	0.348	2.20 "	0.765
4	3.72"	2.14"	0.348	2.17 "	0.755
			1.388		3.095

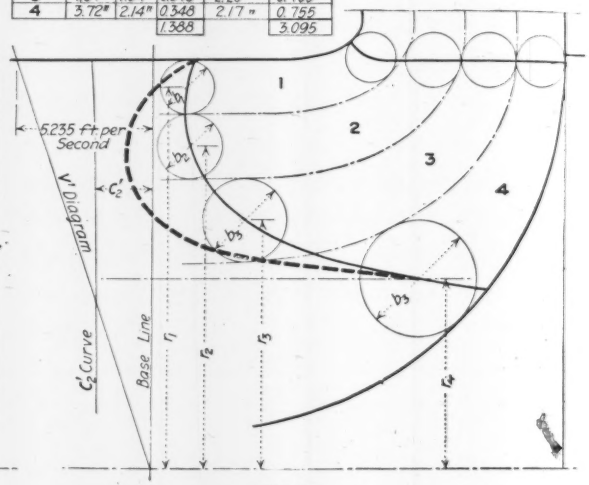


FIG. 2

ENTRANCE AND DISCHARGE EDGES FIRST ASSUMED

determines the speed of the runner. The peripheral velocity at D_1 is

$$V_1 = \frac{\pi Dn}{60 \times 12} = \frac{\pi \times 16 \times 75}{720} = 5.235 \text{ ft. per sec.}$$

n being the number of revolutions per minute.

The peripheral velocity varies directly as the diameter, being zero at center and, as shown above, 5.235 ft. per sec. at $D_1 = 16$ in. A straight line through these points becomes our speed diagram, and we can readily measure the peripheral velocity at any point along the discharge or entrance edge.

The second group of velocity quantities comprises the discharge and entrance velocities in the plane of the flow line and at right angles to the peripheral velocity. We have the discharge given as $Q' = 3$ sec.-ft. The total free discharge area is 1.388 sq.ft. (see table, Fig. 2), but this must be corrected for vane thickness—an item depending on vane angle and type of vane (steel plate or cast iron). Here we will assume that the vane cuts off 5% of our total area; then our total effective discharge area becomes 1.32 sq.ft. The mean discharge velocity is then $C'_2 = 3/1.32 = 2.24$ ft. per second.

Experience seems to show that the actual discharge velocity is slightly greater than this mean velocity at the outer sections and slightly less at the inner sections (though this is disputed by some authorities). Our diagram for C'_2 is then practically a straight line, increasing slightly at the rim (see Fig. 2). The entrance-edge velocity, C'_1, is computed in similar manner, and for this type of runner seems to be practically constant across the bucket edge. The entrance vane angle is to be 90°, and the discharge angle β_2 will be determined by the value of C'_2 and V'_2 at the point in question (see Figs. 4 and 5).

A full discussion of relative and absolute velocities, velocity diagrams and vane angles cannot be included within the scope of this article, but the reader has only to refer to any of the many full discussions of this phase of the subject—notably the paper by Prof. S. J. Zowski, "A Rational Method of Determining the Principal Dimensions of Water Turbine Runners," in *Engineering News* of Jan. 10, 1910, and the recent book, "Hydraulic Turbines," by R. L. Daugherty.

We have determined the flow lines, the velocities at entrance and discharge in the plane of these flow lines at right angles to the tangential or peripheral velocity of the runner, and also the peripheral velocity of the runner, which in turn determine the form of the bucket vane at entrance and discharge—in the given plane of the flow line. We are now in a position to determine the intermediate surface of the vane. We are to deal with warped surfaces which cannot be determined mathematically. The objective is a smooth, eddyless flow from the first few inches of the vane at entrance to the last few inches at discharge.

There is some difference of opinion as to the exact form of the vane near the edges, some advocating an involute, others a straight line. Without discussing this point, however, which at best seems to be a matter of opinion, we will use a straight line, our vane surface to join the straight-line edges. At this point a study of vent area of the bucket is of assistance in determining the length of the straight portion of the bucket in from the edges.

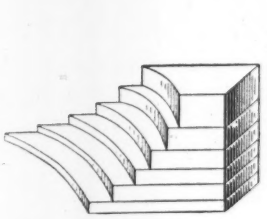


FIG. 3

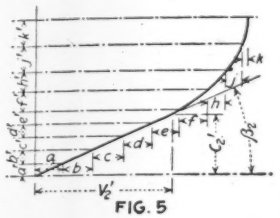


FIG. 5

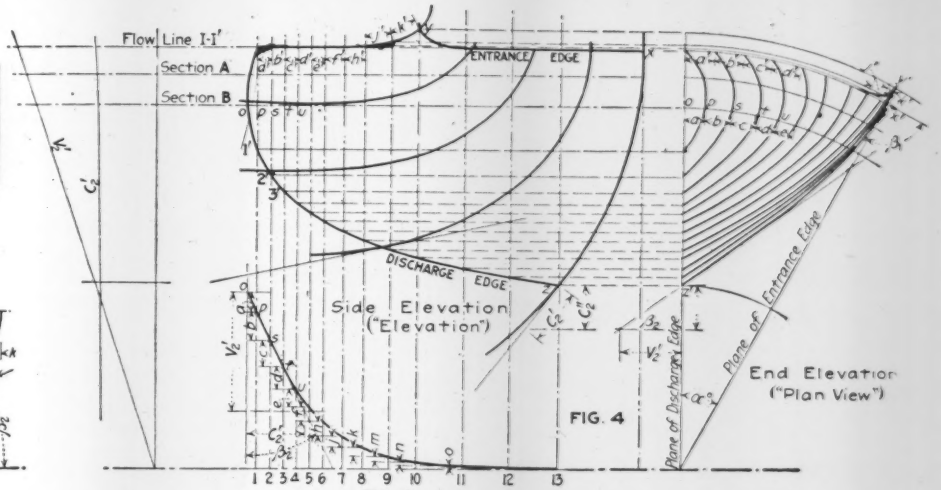


FIG. 4

FIG. 6

THIRD STEP GIVES VELOCITY DIAGRAM AND BOARD CURVES

We will cut the runner by a series of plane surfaces perpendicular to the center line (called "board sections"). The traces of these surfaces are shown by the straight lines 1, 2, 3, 4, etc., in Fig. 4. If we determine the curves that the vane cuts in each of these surfaces (see the "plan view" in Fig. 4) and cut these curves on boards the thickness of the space between the respective surfaces, then placing each such board in its proper relation to the others we have a stepped outline of our vane surface as illustrated in Fig. 3. This is easily cut down to the smooth surface of our vane, and we have a practical working form of one side of our core box.

The discharge edge of the vane is in one radial plane and in plan appears as a straight line. The entrance edge is taken in this case in one radial plane and for the most of its length runs parallel to the center line (x, y). Each board section cuts the discharge edge at a distance 1—1′, 2—2′ (Fig. 4) from the center, and this point is shown in the plan as a point on the board curve. Our outer flow lines run parallel to the center line at the discharge, so that, if we cut the vanes by a cylindrical section, we will show the vane with its proper discharge angle in the development of such a section, as β_2 must be measured in the direction of flow lines.

The development of the cylindrical section B is shown in Fig. 6. Looking at the elevation, Fig. 4, imagine the discharge edge in the plane of the paper and the entrance edge in front α degrees. It will be seen that point p. on the vane surface, lies a certain distance in from o, point s a certain distance in front of p, and so on. The development curve, Fig. 6, determines these distances at a and b respectively; and these are in turn laid off on the trace of the cylindrical section in the plan view, which is a circle, and become points on their respective board curves.

It must be borne in mind that the full development of the bucket vane on different surfaces, the flow surface, $I—I'$, section B, or any other cylindrical or conical section cannot be attained independently of each other. The board curves 1, 2, 3, and 4 in this case will be quite definitely fixed by angle β_2. The line xz' is also fairly closely determined, although there is some latitude in the choice of angle α. With these first curves closely determined and all points on the discharge edge fixed, in the plan view, we can work in free-hand the remaining curves, then go back to our developed sections and check back and forth until we have smooth, symmetrical curves in all cases. We may find it necessary to change our assumed entrance and discharge edges to attain this, which means the checking back over considerable of our computations.

The development of many sections is advisable, using conical sections when necessary to develop δ_2 in the direction of flow. The taking of several radial sections, as shown in Fig. 7, at I, II, III, and IV, aids greatly in getting a perfectly smooth surface (free from pockets) throughout: these sections are used in repro-

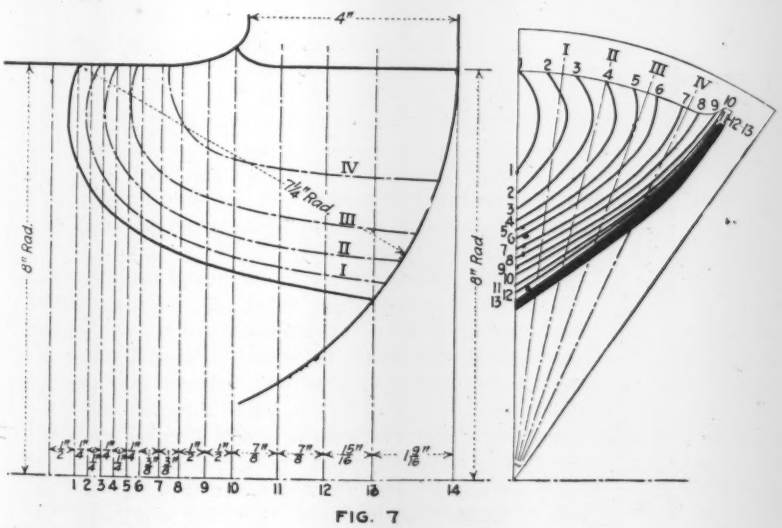


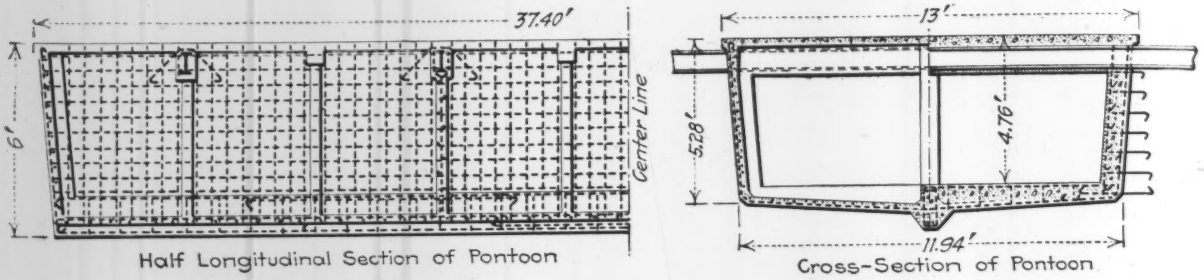
FIG. 7

SMOOTHNESS OF BUCKET SURFACE IS TESTED BY RADIAL SECTIONS

ducing the runner to other sizes. Draw a radial line through the plan view, and mark off on each respective board section the radial distance at which the board curve cuts the line. The resulting curves are shown in elevation in Fig. 7.

Floating Dock on Concrete Pontoons

AN UNUSUAL solution was found for the problem of building a new dock and clubhouse for the Zürich Yacht Club, Zürich, Switzerland, as described in the *Schweizerische Bauzeitung* of Aug. 18. The variations of lake level, amounting to 6½ ft. maximum, made a floating structure necessary. For permanence the float was made of six reinforced-concrete pontoons covered by a continuous reinforced slab. Each pontoon is 13.1 x 37.4 ft. in plan. The drawing herewith shows the essential elements of construction.



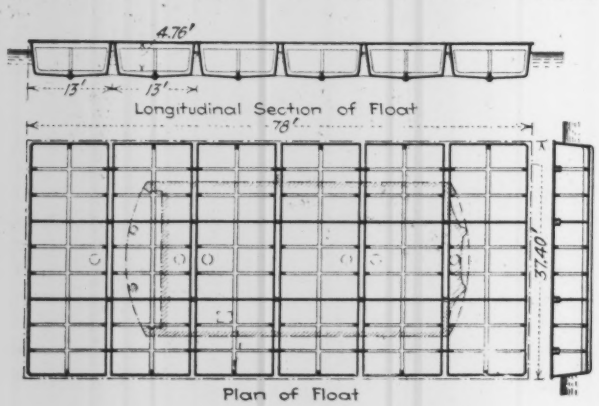
REINFORCED-CONCRETE PONTOON FLOAT FOR BOATHOUSE OF ZURICH YACHT CLUB

The clubhouse, a wood-frame building, weighs 80 tons, and the live load (people, snow, stores) about 33 tons. Rigidity and stability were desired, in addition to the requisite carrying capacity. The float weighs about 200 tons. The loaded draft is 4 ft. It is anchored by five chains attached to concrete blocks of about 4 cu.yd. each, sunk at some distance from the float; the anchorage is designed more for wave attack in spring storms than for wind pressure or boat impact.

The pontoon walls are 2½ in. thick. Below the water line they were successfully treated with Ceresit, inside and outside, for watertightness.

The pontoons were constructed separately on shore, supported on two sets of skids, and the keel girder was reinforced to be adequate for carrying the dead-weight under this double-cantilever condition. Launching was done after 6 to 7 days. Four longitudinal 8-in. I-beams concreted in below deck level tie the scows together. The deck slab is 3½ in. thick. There are also four reinforced vertical ribs between adjoining pontoons, the steel being molded in the pontoon originally and the rib being poured in a form when the pontoons were afloat and joined.

The float is supplied with water, gas, telephone and electric light by way of jointed pipes and cables under water. Sewage disposal could not be arranged for by this means, however, and therefore a small disposal plant is provided in one of the pontoons; it comprises two settling tanks, a percolating filter 40 in. square by 32 in. deep, and an ejector. Another pontoon contains gasoline supply tanks, and a third is used for bottle storage.



GENERAL DESIGN OF FLOAT

The reinforced-concrete work was designed by Zehntner & Brenneisen, engineers, of Zürich, and was constructed by Bosshard, Steiner & Co. of the same city. The structure has been in satisfactory service for 1½ years, it is stated.

To Prepare Street Code in Cleveland

Several meetings have been held by representatives of the Civic League, the Engineering Society and the Electrical League, all of Cleveland, Ohio, for the purpose of discussing a street code which will provide for proper organization of street work, including the placing of sub-structures, the preparation of permanent plans and records and an effective coördination of street functions. The great weakness of having a repair department distinct from the engineering department has been emphasized, and an attempt is being made to draft ordinances which will cover all the defects in the present system. While recognizing the difficulty in drafting a code comprehensive enough to accomplish this purpose, the paving committee of the Civic League expects to submit a report late in the fall. If such a code can be framed, it will be the first of its kind in the country.

The need for adequate cost records is another matter which the conference has taken up, so that sufficient data may be collected to determine with some accuracy the width of pavement, thickness of base, type of pavement and apportionment of cost between city and property owners. Some effort is being directed also toward improving the appearance of street fixtures by regulating their use and location and avoiding, wherever possible, the duplication of fixtures. In fact, the whole subject of street improvement is under discussion by a board of public-spirited engineer citizens.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Serial Bonds for Road Building

Sir—The article, "Serial Bonds for Road Building Save Money," by M. O. Eldridge, in *Engineering News-Record* of Aug. 30, p. 407, might convey to the casual reader the impression that a particular type of partial payment possesses an inherent mathematical superiority over all other types.

Superficial study shows that such is not the case. Unfortunately, the author draws a general conclusion from a particular example. He assumes that annual payments, including principal and interest, must be equal for sinking fund and annuity bond issues, while they may be made to vary in case of serial bonds. There is no reason why the amount set aside each year for a sinking fund or the annual payment on the principal of an annuity bond issue cannot be adjusted to make the total annual payments vary as shown for serial bonds, in the author's Fig. 4—in which case the three forms become economically identical, provided that the sinking fund yields the same rate as the bonds.

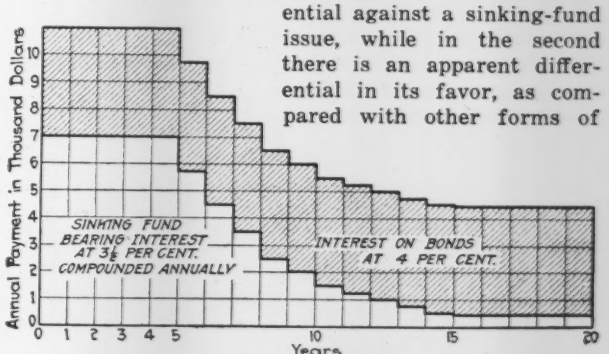
The author's Fig. 3 revised upon this basis becomes identical with his Fig. 4, the annual payments on principal being equal. His Fig. 2 revised upon this basis and assuming 4% compound interest on the sinking fund becomes identical with his Fig. 4 except as to the division line between interest and principal, which is of no importance to the taxpayer. It is, therefore, apparent that the total amount to be collected to liquidate the debt finally is dependent on the rate, or rapidity of repayment, and not on the form of the bonds.

In fact, there is presented herewith a plan of repayment for a sinking-fund issue which, in spite of an adverse interest differential, requires a smaller total payment than any plan suggested by the author. This plan, as well as the plan shown by the author in his Fig. 4, has the disadvantage of high payments the first few years, the payments being reduced toward the end of the period, while the ability of the community to make payments may run in the opposite way. If under the serial plan it is possible to make a payment of $9000 in the first year, it seems reasonable to assume that an equal or greater payment could be made in each succeeding year, under any of the plans of repayment, thus shortening the term of the bonds, and, according to the author's criterion (the total payment), making a tremendous saving.

With reference to the sinking fund examples presented, it should be said that it is admittedly poor business to borrow money at 4% to loan at 3½%. This, however, is a practical point, dependent upon circumstances in any particular case, should be introduced as such, and should not be made the basis of a general mathematical conclusion. It is possible for the sinking fund to yield more than the rate on the bonds, thus reversing the situation, and in order to make a fair mathematical comparison the rate of interest on the sinking fund should be assumed to be the same as the rate on the bonds.

In adopting as the criterion of economy the total amount to be collected from the taxpayers, Mr. Eldridge assumes that the community has a surplus of money which is less useful for other purposes than for application to the bond issue. In such a case, the annual payments should be made as large as possible, and the term of the bonds shortened—in theory the maximum economy is attained by paying cash for the improvement. If conditions are reversed and money is worth more to the community than the rate on the bonds, there will be an interest differential in favor of the issue, and it will be to the theoretical advantage of the community to make the term of payment as long as possible—again in theory, the maximum economy is attained by making the bonds perpetual.

In the first case there is an apparent interest differential against a sinking-fund issue, while in the second there is an apparent differential in its favor, as compared with other forms of issue, but the variation in the market price of the bonds eliminates this discrepancy.



100,000 Dollars, 20 Year, 4 Per Cent. Sinking Fund Bond
REQUIRES SMALLEST TOTAL PAYMENT

It may be argued that the examples presented by the author are typical, but they are not necessarily so, and any reform movement started should be based on correct arithmetic.

The writer is not an expert on bonds, and has no desire to recommend or condemn any particular form. It seems, however, that Mr. Eldridge's practical objections to the sinking fund bond are well taken, especially when considering small communities where the fund must be handled by continually changing officials, many of whom have had little previous banking experience.

JULIAN HINDS,
Assistant Engineer, U. S. Reclamation Service.
Denver.

Sir—Your article on highway bonds, in *Engineering News-Record* of Aug. 30, p. 407, so interested me that I sent to the Department of Agriculture for Bulletin 136 on this subject, to see whether it contained tables on amortization by equal annual payments. Table 23, I find, gives this information, based on payments being made at the end of each period. As the basis of payment provides that the annual sum plus compound interest shall equal the principal, why should not the payment be made, or deposited as safety fund in advance—thus gaining advantage of the extra interest? This would make these payments coincide with the interest payments, which are usually called for in advance.

While this procedure would, of course, be impracticable for ordinary loans (if amortization is to start at once) it could well be followed for sinking funds or mortgage reductions on a growing proposition, for example, if payments are to start, say, p years after the loan is made and it is to be paid off in n years (a usual stipulation with long-term loans), make the first payment at the start of the n year period, giving as the formula

$$S_n = \frac{1}{(1+i)^{n+1}} - \frac{1}{(1+i)}$$

This will make the difference in a ten-year period of over $30 a thousand in the amount of annual payments, at 4%, and for other periods and percentages a proportionate saving will be made.

While this is rather a financial than an engineering problem, it is of interest to engineers in that almost all projects are financed by bonds or loans which should be amortized, and the amortization usually starts after a certain period allowed to place the project on its feet as a going proposition. To save even $750,000 on a ten-year $25,000,000 bond issue is worth considering.

R. AUSTEN MCCULLOCH.

New York City.

Macadam Roads in the War Zone

Sir—I have read the arguments following the publication of William J. Weir's article on macadam roads in the French war zone in your issue of Sept. 13. I have been trying to find out why it was necessary for several highway or material engineers to explain why waterbound macadam roads are in the discard, and to show anxiety when *Engineering News-Record* publishes such an article, and then in its editorial columns even hints that a waterbound macadam road might possibly be of some use. Mr. Weir's article dealt with facts just as he saw them, and they were certainly interesting to most highway engineers. But when he allowed a little theory to creep in, as when he wonders what would happen to the bituminous macadam, concrete and brick roads of the United States if they were subjected to the traffic that he saw on roads in France, that must have spoiled his story for some.

I do not believe many highway engineers think that the modern highways of brick, concrete, etc., as they are being built in the United States, would have lasted much longer than the macadam roads in France, when pounded night and day for months and months by that terrific traffic of all kinds. Nor does any one believe that a concrete road or a brick road would withstand the blow from a Boche shell any more than a macadam road.

If France had had roads of this type would the army engineers have erected detour signs when these routes were in need of repairs, brought up cement, sand, brick, and concrete mixers, and closed the roads for several days for the material to set up? Not for one minute! They would have covered them with stone and made a macadam road and kept the traffic going.

The writer believes in concrete roads, brick roads, bituminous roads, and waterbound macadam roads, but in their places, and the macadam road has a place just as much as concrete or other types. But the waterbound macadam road has no paid promoters to tell of its good qualities and when to use it, and no association of manufacturers to see that the materials that go into it are right, or that the building is carried on according to a well-established theory worked out by high-priced research specialists. The fact remains that if a census could be taken, probably over 75% of the so-called improved roads of the world are of the waterbound macadam type, and will be for years to come, getting the people out of the mud when they would still be stuck if they had to wait for all roads to be of this so-called permanent type.

CHARLES A. CARRUTH,
Assistant Engineer, New York State Highway Commission.

Rochester, N. Y.

The Engineer in Politics

Sir—The recent action of the executive board of the Cleveland Engineering Society, declaring against the initiated rapid transit commission ordinance to be voted on at the November election in Cleveland, is a progressive answer to the archaic dictum that the engineer and the engineering society shall keep aloof from politics. It is amusing to hear some of the staid members of the profession, who ought to be more consistent and logical, preach with eloquence, while standing on one foot, that the engineer should take a prominent part in public life—then shift to the other foot and wax equally eloquent against our taking part in politics.

What is politics? It is the proper relation between citizens, as individuals or in groups, and government of city, state and nation; or the conduct of government through group relationship. Politics is a word sinister to those who fail to do their citizenship duty. If the word carries the suggestion of trickery or dishonesty in public life, that is the fault of those who stand apart, who say we shall have no hand in purifying the unclean.

Whether or not we shall contend in the political arena is not a proper subject for debate, but whether the things for which we strive are right and serve our Government. No service can be interpreted in these fast-moving times except by action. That we shall make mistakes is admitted, but with so many engineers in public life competent to sit in our councils, we should make substantial advances for the public and for our class, the engineers. Concerted action will come with class consciousness.

Of course, the best place in which to be effective in politics is where the votes are counted, in the home of the local engineering society. In national affairs there are opportunities for such a body as the Engineering Council to voice with authority the sentiments of all engineers, and then, if their voice is not heard, they can back it up with votes.

C. E. DRAYER,
Secretary, Committee on Engineering Coöperation.

Cleveland.

Use of Catskill Water in 1916

During the year 1916, according to the latest annual report of J. Waldo Smith, chief engineer of the New York Board of Water-Supply, 40,215,000,000 gallons of water were delivered by the new Catskill aqueduct to the city. This water was passed through the aqueduct to Kensico reservoir at rates as high as 365,000,000 gal. per day.

HINTS FOR THE CONTRACTOR

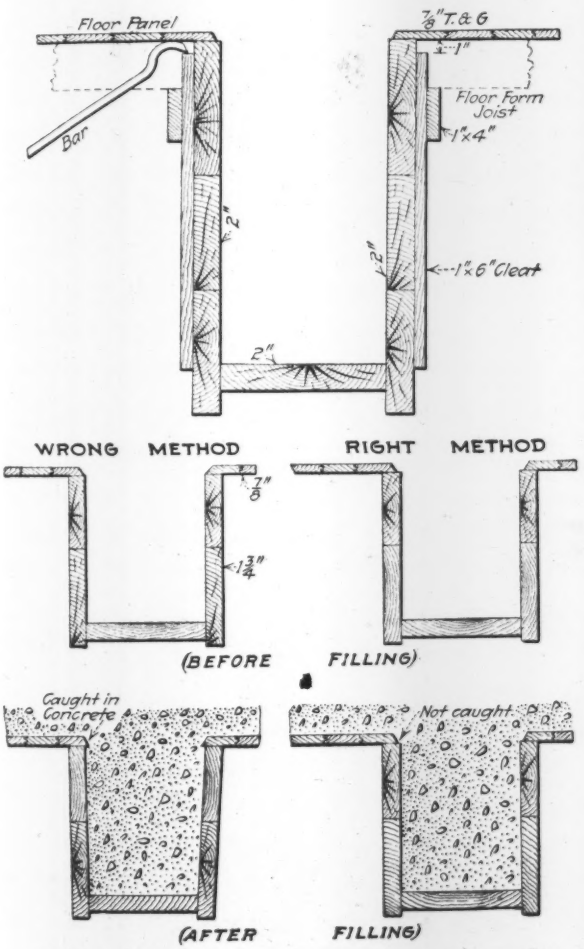
DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Clearance Prevents Slab Form from Getting Caught at Beams

BY SAMUEL WARREN
New York City

MANY A MAN has found it necessary, after his first attempt to build forms, to damage them considerably in removing them, because of their being embedded in the concrete at the ends. This results from not realizing that there will be a slight movement of the forms when they are filled with concrete.

A case in which such clearance is required occurs where the floor slab forms rest on the edges of the beam forms. The wrong and the right methods are shown clearly in the sketch. If the edges of the floor panels are flush with the inside edges of the beam forms, they will be found embedded in the concrete of the beam when the beam forms are removed, as the sides of the beam forms are sure to bulge when filled with concrete.



FORM AT LEFT MUST BE SPLIT TO RELEASE IT

This movement may not be more than ¼ in., but if the floor panels are embedded in the concrete even that slight amount it will be impossible to remove them without virtually destroying them.

Steel Brooms Fitted to Steam Roller Spread Stone on Road Work

IN THE construction of waterbound macadam a saving in manual labor has been effected by attaching a gang of brooms to a steam roller. The steel brooms are clamped to pipe handles which telescope into larger pipes attached to a cross frame. This arrangement permits the making of alternate long and short handles, so that the brooms overlap. The back of the cross frame has three short pieces of pipe, with bolts for securing it to the roller frame. A rope or lever, connected to the front bar of the cross frame, provides for raising the brooms when not in use.

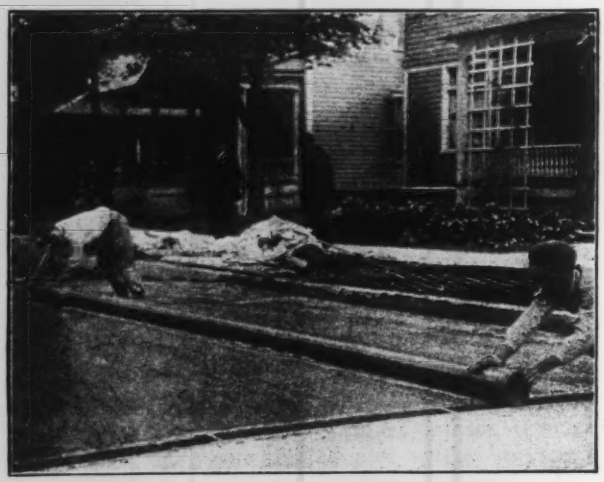
GANG OF BROOMS, ATTACHED TO ROLLER, IS USED TO SPREAD STONE ON MACADAM ROAD WORK

This gang-boom arrangement was designed and made by F. J. Lees, of the highway department of Onondaga County, New York.

Length of Pipe Used To Roll Concrete Paving Transversely

ROLLER floating of concrete street paving at Binghamton, N. Y., eliminates all hand finishing. A 20-ft. length of 6-in. pipe is used, the expansion-joint spacing being reduced from 36 ft. to 20 ft., so that the forms for the expansion joint may serve as templates for the roller. As soon as the concrete has been poured the pipe is rolled over it, two or three passages being required ordinarily to press down the high spots and fill in the low spots.

This method of finishing the pavement was suggested by W. Earl Weller, city engineer. The contractor is



LONG PIPE ROLLER FLOATS CONCRETE PAVING

Frank Stento. The price on the work illustrated is $1.67 per sq.yd. for the pavement complete, plus $1.70 per 20-ft. section for additional expansion joints.

Sectional Camp Houses for 80 Laborers Moved in Day by 24 Men

ROAD CONSTRUCTION camps of timber buildings made in unit parts which can be used interchangeably are used by the highway department of Onondaga County, New York.

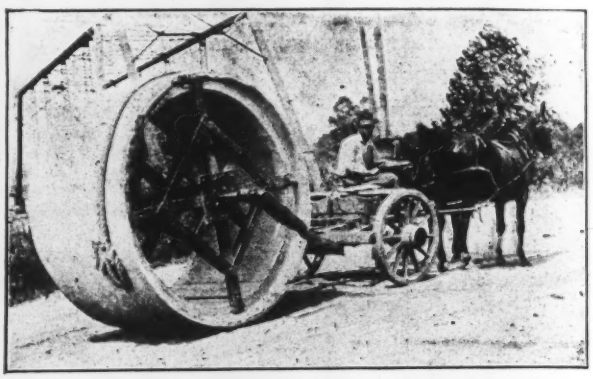
The sides are made of 18-ft. panels having tongue-and-groove sheathing on studding attached to 2 x 4-in. top and bottom plates. Each panel has two windows. The end studs have bolt holes for the attachment of side or end sections. Each end is made in two panels, the upper one closing the gable and the lower one containing the doors. The roof is carried by unit A-frames having two sides and tie, all of 2 x 6-in. plank. These are spaced 3 ft. c. to c., and rest on the side studding. Upon the frames are carried panels 3 ft. wide, a plank covering each inclined joint and a sheet-metal ridge covering the top joint. The floor is made of joists with 1-in. boards laid loose upon them.

The bunk houses accommodate ten men per 18-ft. section and can be made of any desired length. The view shows two 4-section houses for a gang of 80 men. For this gang there are also a three-section mess room, a two-section kitchen and office building combined, and a one-section mess room. The five buildings require 14 sections of 18-ft. length. Two gangs of 12 men each can take down and reërect the camp in one day. An extra cook house is used while camp is being moved.

These buildings were designed and built under the direction of F. E. Bogardus, county superintendent of highways, and F. J. Lees, who is in charge of the work.

Roll 6-Foot Concrete Pipe from Casting Yard to Trench

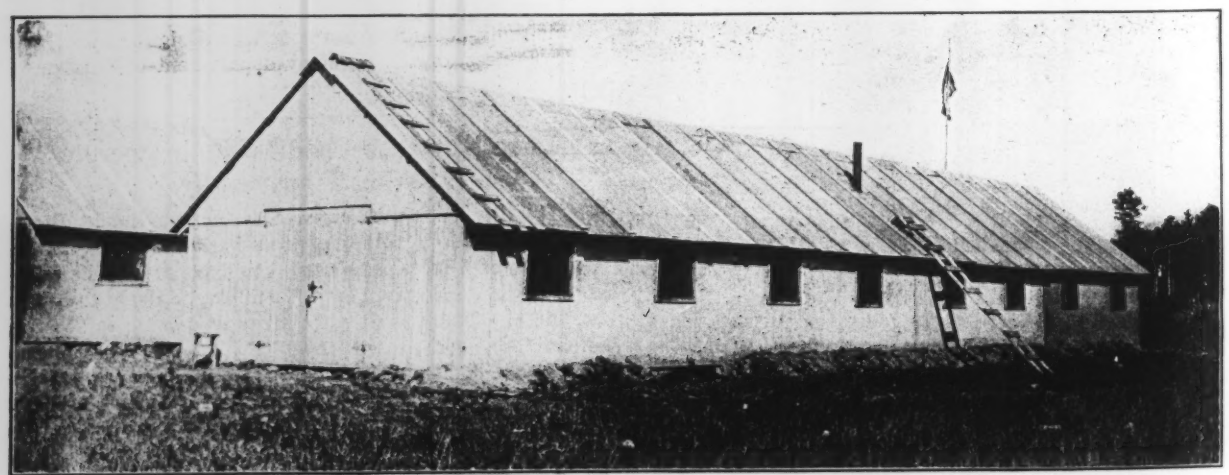
BY PLACING a steel spider frame with an axle inside of 4-ft. lengths of 72-in. concrete pipe, the pipes were hauled by a team 1½ mi. from the casting yard to the trench. To prevent cracking the bell end, a rope was tied around each pipe, as shown in one of the photographs. The pipes are intended for an 8100-ft. sewer



HAUL CONCRETE PIPE 1½ MILES TO TRENCH

in Indianapolis, Ind., for the Speedway Realty Company.

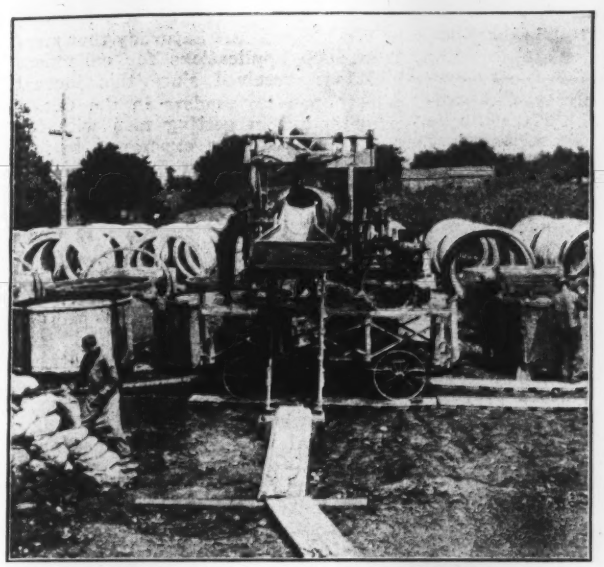
The pipes were cast in pairs in parallel rows. A one-bag mixer, mounted on an elevated platform, traveled along the rows, the charging skip being let down



SECTIONAL CAMP BUILDINGS ON COUNTY ROAD WORK EASY TO MOVE

on a track to the ground level. Usually, a gang of 14 men cast 20 pipe sections each day. Part of the gang stripped the pipes cast the previous day and turned on their sides pipes 72 hours old, while the remainder began to erect forms. By 10 a.m. six or eight forms were ready, and the mixer was started. Then concreting and form erection proceeded until 20 pipes had been cast. This work was finished in time to permit the cutting of 20 rings of reinforcing for the succeeding day's work. Pipe was cured 30 days before being hauled to the trench. The outfit included 20 sets of forms and 60 bottom rings.

In cold weather, steam curing was resorted to. The heat was retained under waterproof fabric covers, one for each group of four pipes. The steam was turned on full for an hour, and until midnight the temperature was kept at 80° F. In the morning steam was applied again for a short time before stripping. The schedule of 20 rings per day was kept up by this means. The Wayne Sewer and Drain Co. had the contract, and H. B. Emerson was its superintendent on the work.

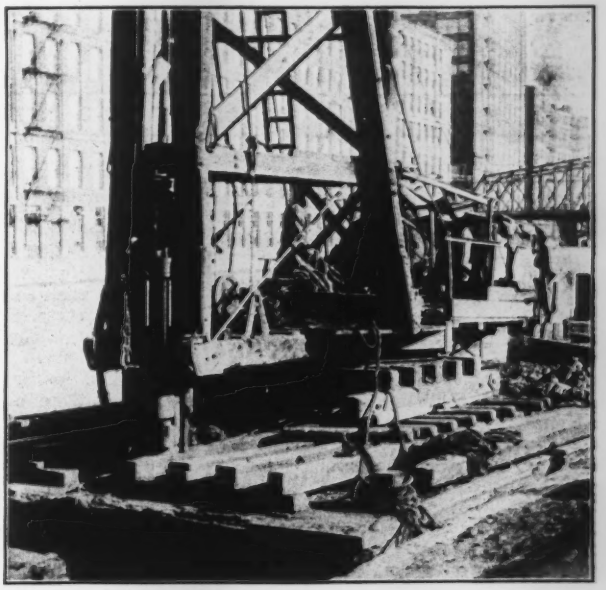


MIXER MOUNTED ON PORTABLE ELEVATED PLATFORM CASTS TWO PIPES AT EACH MOVE

Turntable Driver Mounted Partly on Land, Partly on Barge

By H. H. Field
Chicago

A TURNTABLE pile driver used by the Great Lakes Dredge & Dock Co. at the new Union Station site in Chicago is made to drive piles along the shore and out into the water by rolling it onto a barge. The machine can, of course, be turned to work on either side of the scow or rolled from end to end. It is counterbalanced so that it can reach quite a distance ashore from the end of the barge. Furthermore, as shown in the photograph, skids are set on the shore level with the runways on the barge, so that the machine can be rolled right onto the land. When used in this way, movement along the bank is obtained by rolling the driver back onto the scow and warping the scow along the bulkhead.



TURNTABLE MACHINE MOVES BETWEEN BARGE AND SHORE

This arrangement makes it possible to move the driver very rapidly with a small crew and adjust it to the work of both a land and a floating rig.

Toolbox Has Watertight Lids

A MOVABLE center lid of flashing provides watertight joints for the doors of a portable toolbox used by the highway department of Onondaga County, New York. The doors are hinged at the sides and close against the narrow top of the box, as shown. The joints are covered by the metal flashing, which is hinged so it can be raised clear of the box to permit the opening of the doors. The flashing is attached to double-jointed three-leg hinges. Each hinge is made by riveting together the adjacent legs of two strap hinges. One of the outer legs is attached to the flashing and the other to the top of the box. Thus the flashing has a longitudinal movement as it is raised or lowered.

HINGED FLASHING MAKES DOORS OF TOOLBOX WATERTIGHT

This arrangement was devised by F. J. Lees, who is in charge of the road gang, and the toolbox was built by the gang.

NEWS OF THE WEEK

American Highway Association Is Disbanded

Action Taken on Ground That Organization's Mission Is Fulfilled—Annual Medal To Be Awarded

By vote of the board of directors at a meeting in Washington, D. C., Oct. 30, the American Highway Association has been dissolved. This action was taken on the grounds that the association's mission had been accomplished, inasmuch as every state now has a state highway department working closely with the United States Office of Public Roads. The organization's funds are to be employed to purchase a medal to be awarded annually for conspicuous service in the advancement of road improvement in the United States. The resolution by which the association is disbanded follows:

"Whereas, The American Highway Association was organized in 1910 as a voluntary association to aid in bringing about efficient road administration in the United States and their subdivisions and to arouse and stimulate sentiment for road improvement; and

"Whereas, Every state now has a state highway department working in close relations with the United States Department of Agriculture, and the public interest in the improvement of roads is widely manifest; and

"Whereas, It is thought that the conditions brought about by the war have made it unwise to solicit further contributions from the public for the purposes of this association; and

"Whereas, In view of the facts recited, it is considered best that this voluntary association be dissolved and disbanded; and

"Whereas, There is in the hands of said association the sum of $——, after paying all debts and liabilities which said voluntary association has incurred; now, therefore, be it

"Resolved, First, that a committee of three, namely, Fairfax Harrison, Logan Waller Page and John M. Goodell, be and the same hereby is created and appointed for the following purposes, namely:

"(a) To buy bonds with the said net sum of $—— and to deposit them with the Washington Loan and Trust Co. of the City of Washington, under such deed of trust or other agreement as said committee may deem best for the preservation of said bonds.

"(b) To appoint and legally authorize in said deed of trust or agreement the present Secretary of Agriculture, Hon. D. F. Houston, and any Secretary of Agriculture who may from time to time be incumbent of said office, to collect the interest from said bonds; and from and out of said interest the present Secretary of Agriculture, while he is incumbent of said office, and any other Secretary of Agriculture who shall from time to time be incumbent of said office, shall and he hereby is authorized and empowered to purchase a medal or such other prize or award as he may deem suitable, to be awarded and given to the person or persons under such rules and regulations as said Secretary of Agriculture, or any other Secretary of Agriculture who shall from time to time be incumbent of said office, may promulgate from time to time, the same to be awarded and given annually for conspicuous service in the advancement of road improvement in the United States, and to be known as and called the American Highway Association prize.

"Second, that said committee be and it is hereby authorized and empowered, fully and particularly, to carry into effect the purpose and intent of this resolution, and to make, execute and deliver any deeds of trust or agreements that may be necessary thereunto, and to fully provide in said agreement or deed of trust for the further investment from time to time of said fund by the said trust company or otherwise as it may deem best.

"Third, that the said voluntary association, the American Highway Association, be and the same is hereby disbanded and dissolved and any and all powers or authority which it may have is hereby invested in said committee."

It was unanimously voted to assign the copyright of the Good Roads Year Book to the D. Van Nostrand Co., of New York, N. Y., dated Oct. 15, 1917, the transfer of the copyright to become valid upon delivery to John M. Goodell of a receipt signed by the Williams & Wilkins Co., of Baltimore, for payment in full of all charges against the American Highway Association.

A review of the history of the association was ordered prepared by John M. Goodell, to whom a vote of thanks was given.

St. Paul Railway Will Rush Cascade Electrification

To utilize water power and help conserve the nation's fuel resources, the Chicago, Milwaukee & St. Paul Ry. has decided to rush the electrification of its Cascade section, from Othello, Wash., to Seattle and Tacoma. The section is 211 miles long. In order to save as much time as possible, contracts for the locomotives and power-transforming apparatus have been divided between the Westinghouse Electric and Manufacturing and the General Electric companies.

Road Builders' Regiment Has More Than 5000 Applicants

Last Week More Than 1000 Men Were in Uniform at Camp Meade—500 Applicants Received Daily

Volunteers are still applying in large numbers for admission to the Twenty-third Engineers, the road-building regiment now being organized for early service in France. Col. E. N. Johnston, commanding the new unit, told *Engineering News-Record's* representative in Washington last Saturday that more than 5000 applications for enlistment had been received since this journal called upon its readers in the Oct. 4 issue to aid in getting men with the proper construction experience to join the colors. Of these 5000 applicants 1012 were already in uniform at Camp Meade, Admiral, Md., while 300 more accepted men were en route to camp from all parts of the United States. The remaining applications are being classified as fast as possible and will furnish a large additional quota of highway construction men. At the present time enthusiasm for the road-builders' regiment has been worked up to such a pitch that 500 men are seeking admission to its ranks each day. The special need at present, according to Colonel Johnston, is for bridge carpenters and bridge foremen.

An indication of how engineers throughout the country are responding to the call of the Twenty-third Engineers is given in the following telegram received by Colonel Johnston from B. Hales, city engineer, Ray Junction, Arizona:

"C. O. 23rd Engineers.

"Yours received. My assistants all gone to army. Necessary for me to secure man to fill my position here. Will you allow me until Nov. 15 to leave here for service?"

Last week the highway unit had reached such proficiency in close order drill that they engaged in a formal review at Camp Meade.

Colonel Johnston estimates that at the rate the applications are coming in the regiment will have been recruited to full strength by Nov. 15. The regiment now needs, according to information furnished *Engineering News-Record*:

Axemen, 18; bakers, 6; barbers, 12; metal tire repairers, 6; caterers and head cooks, 12; interpreters, 12; masons, 30; pump repairers, 6; quarrymen, 72; riggers, 12; tailors, 12; telephone men, 24; rubber tire repairers, 24; tool sharpeners, 12; wagon masters, with rank of sergeant, 12; well borers, 6; wheelwrights, 12; derrick engineers, 12; and water-supply men, 6.

Part of Coast and Geodetic Survey Now in Army and Navy

In an executive order dated Sept. 24, 1917, President Wilson, acting in accordance with the authority given him for the purpose, declared a national emergency existing and directed that certain vessels, including equipment and personnel, and many engineers in the commissioned personnel of the Coast and Geodetic Survey, be transferred to the Navy Department In addition, many men now part of the commission personnel of the survey are transferred and commissioned in the Officers' Reserve Corps. The passage of the law granting this authority was noted in these columns May 31, p. 474.

Railroads of Canada Will Co-operate in War Work

An organization has been formed at the suggestion of the Canadian Government, to secure closer coöperation among the Canadian railways. It will be known as the Canadian Railway Association for National Defense, and will have authority to formulate in detail a policy for the coördinating of industrial activities in the prosecution of the war and for rendering the most efficient service to the national cause.

The executive committee comprises the following railway presidents: Lord Shaughnessy, Canadian Pacific; H. G. Kelley, Grand Trunk; Sir William Mackenzie, Canadian Northern, and A. H. Smith, New York Central. The main office of the association will be in Montreal.

Validity of the Bone Patent Not Passed Upon

In the news item noting the decision of the U. S. Circuit Court on the Bone patent, in *Engineering News-Record*, Oct. 18, p. 763, a final paragraph of the upper court decision was omitted. This paragraph reads: "With the claims restricted to a matter of location of the reinforcement (the validity of which we need not decide) there is no infringement." On account of this paragraph it is the contention of the patentee, Frank A. Bone, that the court did not decide on the validity of the patent.

It may be said that the upper court decision was in every way an affirmation of the lower court. That lower decision stated that Bone was not the first person to reinforce a retaining wall and that he was not the first person to conceive the idea of a reinforced retaining wall, which was so shaped and constructed that the weight of the earth on the heel of the wall would withstand the pressure of the dirt or the earth on the wall. Both decisions, however, concluded that it was not necessary to decide whether Bone's method or location of reinforcement evidenced patentable novelty, because if the claims of the patent were so restricted and limited the wall under controversy, that is, the wall built for Marion County, did not infringe the Bone patent.

Priority Order to Halt Road Construction

Much Work on Highways Will Be Lost Through Stoppage of All Supplies—Demand for National Road Body Growing

After an investigation understood to have been directed by Robert S. Lovett, the Priority Board of the Council of National Defense issued an order to the effect that open-top freight cars, except flat cars, may not be used after Nov. 1 for shipping:

"1. Materials and supplies, other than coal, for the construction, maintenance or repair of public or private highways, roadways, streets or sidewalks.

"2. Materials and supplies, other than coal, for the construction, maintenance or repair of theaters, or other buildings or structures to be used for amusement purposes."

May Be Lifted Before Spring

There is no official intimation of how long this drastic order will remain in effect. This journal has been informed unofficially, however, that it is hoped the embargo can be lifted long before spring road construction opens.

The immediate effect of the order is to stop from today the shipping of crushed stone, slag, sand and gravel to every highway contract in the country that depends on rail supply. Delivery of brick and cement, and possibly of barrelled asphalt, all of which have been shipped to some extent in the proscribed gondolas because of the scarcity of other cars, will also be curtailed.

Like Bolt from Blue

From reports reaching this journal, most highway work has been caught entirely unawares by the sudden promulgation of the order without a hint of warning. It was explained to the representative of this journal that the Priority Board, realizing that immediate action could not be avoided, no matter what the grounds for protesting the order, decided against hearings on the matter as calculated only to raise a storm of protest which could not in any case help the desperate situation with regard to the transportation of coal. This situation, involving the shutting down of munitions plants and coal famines adversely affecting industry in all parts of the country, is due, it is unofficially stated, to a lack of coal cars. To remedy this severe shortage, it is said, the commandeering at once of all available gondola cars could no longer be postponed.

The action taken came so unexpectedly as to catch many miles of highways graded with no prospect of securing materials to complete them before winter makes morasses of them. Next spring a great deal of work will be required to put these roads in condition for surfacing, to say nothing of the loss of money caused by having them out of service all winter.

Highway engineers have complained bitterly to the editors of *Engineering News-Record* that this condition could have been greatly mitigated if longer notice had been given to all engineers to prepare to close down their work for the winter. Contractors make the same complaint, and may of them undoubtedly face heavy losses.

Agitation for Highway Board

The fact that a matter of such vital importance (the Priority Board itself admits the urgent necessity for road construction) must be decided under the present organization in such a summary fashion by a board primarily concerned with far different duties is pointed to by leading highway officials as final proof of the urgent necessity for a national highway body as a part of the Council of National Defense. Such a body would not, they point out, result in the consideration of commercial and contracting interests of the highway field above the common good. On the other hand, it would prevent serious damage to these interests and serious delays to the development of our sorely-needed road system from action such as the present priority order. Much could have been done by such a body, these officials point out, to mitigate the bad effects of this order. That nothing was done in this direction they attribute to the fact that there is no body now in existence charged with looking specifically after the development of highways and highway transportation.

Federal-Aid Work Suffers

The order does not, of course, apply to materials for Government work. It has not yet been determined whether state roads, which are being torn to pieces by heavy traffic in the vicinity of cantonments and embarkation centers, are included, but it is thought that the Federal-aid state highways will not be considered as Government work.

Neither has any loophole been found to permit the maintenance of the heavily-traveled freight roads in many states, without which important cities, such as Cleveland, could not continue business under present conditions.

Montreal Finds Motor Sweepers Hard To Operate

In the report of Chief Engineer Mercier to the Board of Control of Montreal, Canada, as to the exact defects complained of in the new motor sweepers purchased by the city, it is stated that the chassis is excellent, but that the machine is difficult to operate and slow. In addition, the sweeper is so badly adjusted that on a rough street where there are holes and depressions, it leaves matter which it should have swept up. The cost for 16 days and 15 nights to operate, with the chauffeur and an extra man to help operate the machine, amounted to $317.71, the cost running daily from $17 to $23 for 24 hours.

Government To Build Barges for Mississippi

Transportation Crisis Leads Authorities to Construct Steel Barges to Carry Coal and Ore

INFORMAL announcement of the Federal Government's intention to build a fleet of steel barges for the Mississippi River was made by Secretaries Redfield and Baker in separate interviews last week, although the details of the plan have not been made public. At present the indications are that the Shipping Board will authorize the expenditure of about $3,000,000 to be devoted to the construction of a number of boats, which will be leased to private capital for service between St. Louis and St. Paul, carrying coal upstream and iron ore downstream. The fleet at present planned will consist of four specially designed power boats with 1800-hp. boilers, and 24 steel barges 50 x 310 ft. with a carrying capacity of 1200 tons each at a 3½-ft. draft, or 2500 tons at a 4½-ft. draft. Each towboat will handle three barges and the traffic will be so managed that loaded barges of coal or ore will be ready at each terminal on the arrival of a boat. It is noped that the boats can be put in operation next spring. The lease will be held by the Mississippi Valley Iron Ore Co., of St. Louis, of which E. D. Goltra is president.

This action on the part of the Government follows the completion Oct. 20 of the experimental trip of the steamer "Nokomis." That the subsidy of river boats will be undertaken is, however, due to more fundamental causes than one round trip of a fleet of barges, particularly as that trip was not too successful. War conditions with its resulting disarrangement of old traffic routes and methods, the fact that the Northwest region requires millions of tons of coal and that Southern manufacturers are suffering lack of pig iron, are the primal causes which required this unusual participation of the Government in the revival of river traffic on the upper Mississippi.

No more interesting history of this "revival" will be written than the log of the steamer "Nokomis." A Government snag boat on the lower Mississippi, it was impressed into this service together with six stone barges to enable an enterprising business man in St. Louis, who furnished the cargo, to make an experimental trip. The tow left St. Louis July 31 and arrived in St. Paul Aug. 13—675 miles in 14 days. The barges drew 4½ ft. The water stage was favorable and the boats arrived safely, the most serious difficulty being the finding of pilots. At Rock Island Rapids there was a forced wait of two days, to find a pilot who would undertake this unusual tow over the rapids. Piloting a steamboat—a pleasure packet—the only thing afloat on the Mississippi River in these later days, and piloting a tow of coal barges with its nose poking upstream 600 ft. ahead of the boat, are two different propositions.

On the day the coal barges arrived in St. Paul the daily papers were announcing a coal shortage in the Northwest. This coal was offered for sale but there were no buyers. After three days' waiting, the City of St. Paul purchased the entire cargo to help out the project, the coal being delivered to the School Department at $6.50 per ton delivered, or 80c. less a ton than the market price. The coal was somewhat broken up by handling, about the same as coal delivered by boats at Duluth. At Duluth they are equipped with screens at the docks and buyers can purchase lump coal or screenings, as they wish. At St. Paul there was no such provision, which furnished some excuses for refusal to purchase, but a general apathy, the immobility of business interests, had more to do with it. The barges loaded with iron ore left St. Paul Aug. 28. They reached St. Louis Oct. 20, having been 53 days making the down river journey, due to low water and overloaded barges.

No use whatever was made of the Government storage reservoirs at the head of the Mississippi River at the time the "Nokomis" left St. Paul, to raise the stage of the river between St. Paul and Lake Peppin.

The ore-loading equipment provided this year by the City of St. Paul will be ample to handle all traffic next year, but the coal-handling equipment and storage yard will have to be augmented by the purchase of two locomotive cranes for quickly unloading the coal from the barges, and adding to the storage ground.

Commissioner of Public Utilities O. E. Keller has asked the council of St. Paul for $200,000 in the 1918 budget for improvement of river terminals. This has been cut to $50,000. Mr. Keller has announced that this amount will be sufficient to provide temporary equipment for handling next year's cargoes but that he will go before the people next fall and ask for a large bond issue for the building of permanent terminals equipped with modern coal- and ore-handling machinery, and that he believes that the people will vote these bonds after the object lesson presented to them by next year's traffic.

The railroad companies in the Northwest seem to be perfectly willing to furnish the iron ore, especially the Northern Pacific, from the Cuyuna Range. Railroad officials there say that they are in no way opposed to the revival of river traffic but they always add: "But we don't think it will amount to anything."

Legal Obstacles to St. Louis Street Widening Removed

The St. Louis Circuit Court has removed all legal obstacles to the widening of Washington Ave. from Jefferson to Grand Aves., which was provided for under an ordinance passed in 1912. The proposed improvements have been held up since that time by the filing of exceptions by a number of property owners to the appraisal figures agreed upon by the special commission.

The city's share of the cost will be $60,000, and it is expected that work will start by spring of 1918. The plans call for a widening from 60 to 80 ft., terminating at Grand Ave. in a broad plaza, which will do much to relieve the traffic congestion at that point. The cost at first was estimated at $700,000, but it has since been reduced by $200,000 by allowing certain buildings which project less than 12 in. beyond the new building line to remain until they have been altered or rebuilt.

Arkansas-Louisiana Road Measure Is Upheld by Court

The validity of the Arkansas-Louisiana road-improvement district, said to be the largest in the world, has been upheld by the Arkansas Supreme Court and the bonds will be offered for sale within 20 days. The district will build 178 miles of road through Lincoln, Drew, Desha, Ashley and Chicot Counties, Ark. In Desha and Chicot Counties a total of 122 miles of road, consisting of a concrete base 14 ft. wide covered with 2½ in. of asphalt, will be constructed. This system will cost $3,500,000.

Ordnance Corps Needs Men

A call for volunteers to join the enlisted personnel of the Ordnance Corps of the National Army has been sent to *Engineering News-Record* by Capt. E. A. Rogers, U. S. R., by direction of the Chief of Ordnance. The corps is charged with the supply, maintenance and repair of all cannon and artillery vehicles and equipment; all machines for the service and maneuver of artillery; all small arms, ammunition, harness, motor trucks, motorcycles, tractors and railroad cars. In fact, it is often referred to as the "Army behind the Army."

This journal is authorized to say that there is a place for practically every man who knows a trade in the Enlisted Ordnance Corps. Machinists, mechanics, plumbers, painters, carpenters, canvas workers, auto mechanics, saddlers, blacksmiths and wheelrights are especially needed at this time. Applicants must be between 18 and 40 years, citizens or declarants, and be able to speak, read and write the English language. They should have no absolute dependents and must be able to pass a physical examination conforming to that prescribed for the regular army.

Men of draft age who have not been called by their local boards are eligible for enlistment in the Ordnance Corps.

These instructions are issued to men who wish to enlist: Get application blank by writing to Chief of Ordnance, Enlisted Personnel Division, Washington, D. C. Fill it out, return to Chief of Ordnance, and if there is an opening for you at the time, authorization will be sent you to enlist at the nearest recruiting station.

San Francisco Engineers Study Civil Service

An Endeavor To Improve Conditions Under Which Cities Employ Engineers

Among engineers of the San Francisco Bay region there has been discussion of the improvements needed in civil service regulations if public positions are to be attractive to engineers. It was felt that the civil service system should close public offices calling for engineering ability to men not duly qualified, at the same time that it should prevent an employee who is given a position of trust and responsibility from being continued on the title and salary of a lower rank.

The failure of existing regulations to accomplish this was believed to be responsible for the unpopularity of civil-service positions with engineers. It was pointed out that 30% of the engineers eligible for membership in the San Francisco Association of the American Society of Civil Engineers were affected by civil-service regulations, and the association appointed a committee to study the entire matter.

The committee was instructed to go over and compare Federal, state and municipal civil-service laws and having the advantageous details of all in mind, to recommend such changes in municipal civil-service codes as would enable cities to attract the best type of engineers to public service. It was hoped that the activity of the committee might also interest the parent society in giving attention to the same work on a broader scale.

The committee consisted of Jerome Newman, L. S. Griswold, S. G. Hindes, Franklin Riffle and R. A. Thompson. After consideration of Federal, state and such municipal codes as could be obtained, a report was made giving an outline of the methods followed in the several systems, noting particularly important points of difference and giving a list of salaries accompanying various engineering positions under civil-service regulations of the United States, California, San Francisco and Oakland. An extract of the report has been printed by the San Francisco Association.

Canadian Government Establishes Research Scholarships

The Canadian Government has adopted the suggestion of the Council for Scientific and Industrial Research and established 20 studentships and five fellowships for the promotion of practical researches to aid the development of Canadian industry. The fellowships will be for the more advanced students who have completed their scientific training and shown special ability. A number of appointments to these positions have already been made, those obtaining fellowships being A. D. Hone, A. J. Walker and George H. Henderson. In order to get in touch with the conditions and needs of the industries of the Pacific Coast, the Advisory Council has decided to appoint an associate committee comprising representatives of the leading British Columbia industries, to advise with them on matters specially concerning that province.

No Railroad Traffic Over St. Louis Free Bridge Yet

The new municipal free bridge at St. Louis over the Mississippi River is finally completed and is carrying a large vehicle traffic, but as yet there are no railroad connections at either approach. Since most of the railroads entering St. Louis own stock in either the Merchants Terminal bridge or the Eads bridge, they can see no advantage in using the bridge provided for them by the city. Mayor Kiel has proposed a conference with the railroads to be held next month, at which time he will make an effort to determine upon what terms the roads are willing to use the bridge.

Road Convention Urges Engineer as Cabinet Member

At a recent convention of the Southern Appalachian Good Roads Association, the following paragraph was included in the general resolutions adopted:

"The development of this country's resources is based upon transportation and the solution of the transportation problems are engineering subjects. Therefore, feeling that engineering subjects should be handled by engineers directed by a trained engineer, we indorse the establishment of a Federal department of highways and transportation, the head of which shall be a member of the President's Cabinet, who shall be a trained engineer who has demonstrated his ability as an executive, and who has had actual practical engineering experience covering a period of not less than ten years in the class of engineering embraced in the department controlled."

Prices Stationary and Work Slackening

Scrap Declines on Fixing of Steel Prices—If People Save, Construction Will Feel Less Effect from War Financing

After showing steady advances for month after month over a long period, the price list of engineering materials has remained almost stationary during October. With the exception of gravel, explosives and manila rope, no price advances of a national character are noted. The effect of price fixing for steel products is shown in the scrap-metal market, where prices have very generally receded. In the prices of steel products no changes, of course, are noted; but the question of obtaining material is not one of price but of priority.

While construction work for the Federal Government is of enormous proportions (the Bureau of Yards and Docks of the Navy Department alone is said to have well over $100,000,000 worth of construction under way), private and public work not of a war character is showing more than a seasonal decline. Judging from the number of notices of contract awards reaching this journal, new construction work is less in volume than at any time since 1914. This decrease in ordinary private and public work is naturally attributed to the financing of the national war loans, which would naturally make it increasingly difficult to obtain funds for private enterprises. However, the contractor is not suffering from this cause to the extent that many other businesses must. The enormous amount of Federal construction work under way and direct employment by the Government of many engineers has, to a great extent, taken up the slack created by the lessening of private business. Some even consider that this factor should be given equal weight with the uncertainty of the labor and material markets in accounting for the small number of bidders at such large lettings as have been offered of late. The bidding for the work of the Miami conservancy district will be an interesting index to this situation, as it is understood that unusual efforts are being made to induce a large number of contractors to participate.

As to whether prices will continue to mount because of the growing scarcity of labor, and capital will become increasingly difficult to secure for any private enterprise during the next construction season, much is thought to depend on the way in which the general public assimilates the Liberty Loans. Should workmen and clerks, minor executives and professional men —the sort of people who in ordinary times seldom save anything except insurance, or money to provide for the education of their children—take the war seriously to heart in the early stages of this country's participation, and begin to save in earnest, no ill effects need be feared from the expiration of credit. It is estimated that normally the total new savings invested scarcely amount to $6,000,000,000 a year. If this money were all saved and all invested in Government bonds, and the war revenue bill should yield $3,000,000,000 in taxes, there would still remain more than $9,000,000,000 to be provided for the expenses of the first year of the war. If the Government securities must be taken largely by the banks, currency and credit can scarcely escape inflation which would force prices up. Besides this, credit for every private purpose would have to be greatly restricted. If the general public saves this money, which amounts to but $180 per wage earner, out of its yearly earnings, it is held that there is a good chance for a decline in prices, and it is certain that conditions would be far better with regard to financing of work apart from the war.

Gas and Flame Regiment Needs Volunteers

Maj. E. J. Atkisson, Corps of Engineers, U. S. Army, is organizing the first battalion of a "gas and flame" regiment, the 30th Engineers, at Camp American University, D. C. The new unit, which will be under the command of Col. A. A. Fries, who is now in France as chief of the gas service, needs chemists, chemical workers, machinists, men experienced in gas manufacture, pipe fitters, boilermakers, automobile repair men, electricians, etc.

Men with the proper qualifications, between the ages of 18 and 40, who have not been actually called by a local board in the draft, are urged to enlist. They should go to the nearest recruiting station, state fully their qualifications, and request to be enlisted in the 30th Regiment of Engineers.

The 30th is the pioneer regiment in the gas and flame service. Major Atkisson points out that this organization will require a large proportion of men able to assume responsibility and to act upon their own initiative and individual judgment. There will, he states, be opportunities to advance to the higher non-commissioned grades. There will also be opportunities for commissions.

All men must first enlist as privates, the rate of pay being $33 per month and expenses. Men with the necessary experience may be assigned to special duties and given non-commissioned rank at rates of pay ranging from $40.20 to $96 per month and expenses.

Railroads Must Pay Their Share of New Jersey Highways

It is believed that the decision of Chief Justice Gummere, refusing the railroads a writ of review of the road legislation, has removed the last remaining doubt as to whether the railroads will be required to pay their full share of the $15,000,000 road tax provided for by the last winter's session of the legislature of New Jersey. The decision pointed out that irrespective of the construction placed upon the original act it was clear that the supplement passed later in the session made provision by which railroad properties should bear a proportionate share of the tax burden.

Iowa Water-Works Officials Meet at Council Bluffs

Inspection of the water-works plants at Council Bluffs and Omaha occupied much of the attention of the members and guests of the Iowa Section of the American Water-Works Association at the former city, Oct. 10, 11 and 12. At Florence Station of the Omaha plant the party saw alum-cake for filters in process of manufacture.

Papers read included the following: "Recovering a Pump Lost in a Deep Well," by W. A. Judd, Mason City; "American Water-Works Laboratories," by Jack J. Hinman; "The Presumptive Test for B. Coli," by Prof. Max Levine; "Early Experience in Water-Works Construction in Iowa," by Charles P. Chase, and "Metalium, a Substitute for Lead as a Joint Material," by H. V. Knouse.

The 1918 meeting and hereafter all alternate meetings are to be held at Iowa City and devoted entirely to discussion and business.

The officers elected for the coming year are: S. L. Etnyre, chairman; W. A. Judd, vice chairman; G. E. Shoemaker and B. T. Stedman, directors; Jack J. Hinman, Jr., Iowa City, secretary-treasurer.

Tennessee Highway Department Will Hold Examination

In compliance with a recent law, the Tennessee State Highway Department will hold an examination for assistant highway engineer in the Capitol Building at Nashville, Tenn., on Nov. 19. This examination will qualify engineers for appointment in connection with highway work on Federal and state-aid projects. About ten or twelve engineers are needed immediately, though later there will be other positions open, such as instrument men, rodmen and chainmen. For these last positions no examinations are required. The applicant must submit a statement of his qualifications, which will show his fitness for the position for which he applies. All information desired on various details of the examination or positions open may be obtained by addressing A. M. Nelson, state highway engineer, Nashville, Tenn.

Quartermaster Corps Sends Out Call for Men

The Quartermaster Enlisted Reserve Corps, with recruiting headquarters at 357 Broadway, New York City, has received a new authorization to enlist men to follow their civilian trades in the army, for duty in this country and abroad.

The men particularly needed at this time are: Electricians, tinsmiths, iron workers, carpenters, plumbers, mechanics—auto, mechanics—general, masons, bricklayers, farriers, horseshoers, saddlers, blacksmiths, teamsters, cooks, chauffeurs, stenographers, wagonmasters.

Enlistment is open to citizens of the United States, or to those men who have declared their intentions of becoming citizens.

Kansas Highway Commission Issues Its Own Magazine

The secretary of the Kansas State Highway Commission has been intrusted with the work of issuing a magazine which will be supported from funds of the Commission. The first issue is off the press now, and contains, besides an article by the governor of the State on the commission and its work, an article by W. S. Gearhart, state engineer, entitled, "Types of Roads in Kansas," and Logan Waller Page, on "Central Control in Roadbuilding."

Pittsburgh Bridge Raising Pushed by War Department

The War Department has recently given the Pittsburgh authorities a hint that it would like to know just what steps are being taken to raise the Allegheny River bridges as ordered by Secretary Baker on Mar. 23, 1917, when he declared them to be "unreasonable obstructions to navigation." His order provided for the beginning and completion of work on the seven bridges as follows:

Bridge	Commence Work	Complete Work
Penna. R.R.	Immediately	1 year
Sixteenth St.	Immediately	2½ years
Forty-third St.	Immediately	2½ years
Ninth St.	1½ years	3½ years
Seventh St.	1½ years	3½ years
Sixth St.	2½ years	4½ years
Thirtieth St.	3 years	5 years

The Pennsylvania Lines west, as soon as the order was received, made plans for jacking up its important main-line bridge to the required elevation and that work is well under way. Although a very difficult and slow operation, as it must be done without any interruption to the extremely heavy traffic, General Manager D. F. Crawford has announced that it will be completed within the time limit prescribed. The other structures, all of which are highway bridges, are owned by Allegheny County, which bought them from private owners a few years ago, after three secretaries of war had decided that they need not be raised. As Secretary Baker's decision to the contrary came at about the time when the United States was entering the war, the local officials felt confident that the Government would not press matters until after the war, and have done nothing toward elevating the spans, despite a penalty of $5000 provided by the law for every month's delay after the time limit expires. The U. S. engineer officer in the Pittsburgh district felt that this tardiness in starting the work was prompted by the hope that if delayed until the end of the present administration a revocation of the order might be obtained.

Terminates a Long Fight

After the successful termination of the long fight for higher bridges, started by Capt. W. L. Sibert, now Major-General Sibert, the officers of the corps of engineers appear to be interested in seeing an actual start made in the work before there is any change in secretaries of war. Senator P. C. Knox, on behalf of the citizens of the Pittsburgh district, has represented to the President that to carry on the work during the war would interfere with the production of iron and steel products and war materials in the district, and could not be completed in time to be of any assistance during the war. Also he showed that the work would have to be contracted for at war prices. Secretary Baker replied that "the benefits which will result from alteration far outweigh any local or national inconvenience" and recommended that the petition for suspension be denied. He was upheld by President Wilson.

James Peter Beck

Within a few days after the death of James Peter Beck, late general manager of the Portland Cement Association, the association held a meeting at Chicago. At one of the sessions, set aside for memorial addresses, Richard Hardy, president of the Dixie Portland Cement Co., delivered a eulogy, which because of its sentiment and the interest it holds for Beck's friends is here reproduced in part:

"'In the midst of life we are in death.'

"How strangely true these words strike upon our hearts this morning as we gather here to pay to the memory of our vanished friend our tributes of respect and love. It is most appropriate that we, his associates of a life ended all too soon, should for an hour lay aside all thoughts of the activity that has brought us here, to consider reverently the meaning of the life that was given almost wholly to the work in which we are commonly engaged.

"When the word was flashed to us on Saturday last that Peter Beck had passed into the shadows there came to each of us a sense of deepest loss. Only a few had known that he had been stricken, and these few felt that his rugged strength would withstand the attack of the dread disease that had seized him. They felt there was no need for immediate concern, and within a fortnight it was believed that he would again be at his post of duty. But once more the psalmist's words strike upon our hearts—'In the midst of life we are in death.'

"He commanded our respect and our admiration because of his ability, his clearsightedness, his unusual powers of comprehension and his indomitable industry. He had few idle hours. His thoughts were ever for the advancement of our work and unreservedly he gave of his strength to the promotion of our common welfare. Those who were privileged to know him well found him a most companionable man, and their loss is not easily measured. We have all felt the compelling force of his personality, his ability, his industry and his tireless energy; some there are who have known him as a close and dependable friend; theirs is the greater loss.

"The highest privilege of life is toil, and the privilege of toil is rest. There is a serenity, a holiness, aye, almost a beauty to the ending of some lives. When the relentless years have taken their full toll of strength of mind and body, there is none so unkind as to wish long pain-racked years to him who has served usefully and unselfishly. When the wages are taken and the long day done, there is indeed beauty in the thought that the weary traveler is taken again in the arms of the dear old Earth Mother and softly sung to his rest.

"It is not easy to reconcile ourselves to the passing of a life that held so much of promise as did this life of our departed friend. There seemed so much yet for him to do; so much that he could and would have done; there were still so many avenues of usefulness open to this young life. Yet at the full tide of his usefulness it came to him to join the innumerable caravan.

"It has been good to have met Peter Beck on the way; good to have journeyed with him for an hour or two when life was still kind. We are all the better for having known him, and let us hope that he, too, found something of helpfulness in his associations with us.

"To those who are bound to him by the ties of kinship, we can offer but little. At such a time we realize of how little worth are the words of sympathy that we so freely give—yet it is all we have to give, and to them, we, his associates and friends, send our hearts' sympathy in its fullness. With them we shall often in the coming years turn to the page in our book of memories upon which his name is written.

"To you, Peter Beck, friend, associate, good companion on the way, we bid you: Hail and farewell."

Quartermaster's Supply Depot at Port Newark Terminal

Work on the supply depot for the Quartermaster's Department at Port Newark terminal was begun on Oct. 22. The plans call for 12 frame warehouses, 1100 ft. x 161 ft., at a cost between $5,000,000 and $7,000,000. The site adjoins property leased by the Submarine Boat Corp. for shipyards, which work was mentioned in our columns, Sept. 13, p. 523. The grant to the Government carries with it the right to use 1900 ft. of docking. Direct communication with the Pennsylvania and New Jersey Central railroads is available at this site.

Suggests American Contractors Tackle Channel Tunnel

It has been learned from a reliable source, according to the press of New York City, that the present British ministry has taken up the question of immediately constructing the channel tunnel, described on page 645 of the *Engineering-Record* for Nov. 25, 1916, where it was left off on the retirement of the Asquith ministry. The conclusion reached according to these reports is that the $80,000,000 required for construction cannot well be spared at present; that the skilled labor and engineering talent required are too badly needed at the front; and that there is a lack of adequate construction equipment and of time to perfect and build such equipment. The interesting suggestion made is that this country furnish, privately or publicly, the capital required, and send over our subway contractors en masse, with plant, tools and men.

So far as the New York quota of this hypothetical contingent is concerned, the suggestion may appear in the light of a joke, in view of the serious difficulties reported in summoning enough resources of men and materials to complete the New York subway system.

Illinois Road Engineers Begin Study for New Program

Careful preparation for the expenditure of $60,000,000 in building roads in Illinois is already under way, although the vote on the bonds will not take place until next fall, and construction in any large way is not expected until 1920.

Oct. 19 the heads of departments, division and assistant engineers spent the entire day in Chicago learning the latest word in regard to concrete. The party assembled at the structural research laboratory at Lewis Institute, which is maintained under the direction of Prof. Duff A. Abrams by a coöperative arrangement between the institute and the Portland Cement Association.

For the first time the revolutionary results of the extensive examination of aggregates which has given rise to the function known as "The fineness modulus of the aggregate" were translated into an everyday, usable tool by which the engineer can obtain the greatest strength from a given aggregate. The preliminary results were reported on in an academic way by Prof. Abrams at the last meeting of the American Concrete Institute but have now been confirmed by such an enormous number of tests that there seems no doubt of their value. Practical examples and demonstrations of the use of this method were explained in the laboratory and then the engineers were assembled in a classroom for an exposition of the derivation. Other features explained in detail were the new colorimetric test for organic impurities in sands, wear tests of concrete, effect of rolling on the transverse strength of concrete and the effect of consistency.

Rolling was further studied on the job on the Sheridan Road work in Winnetka. In the evening a round table discussion of the day's events was held.

American Water-Works Association Helps Recruit Engineers

The Twenty-Sixth Engineers, a specialized organization destined for war water-supply service and to operate storehouses and repair shops in France, is having difficulty in getting properly skilled men to fill its ranks. The American Water-Works Association has been asked to assist in this work, and is giving the matter publicity, having announced that six companies, each having a personnel of 250 men, 166 of whom should be skilled artisans, are needed.

The following types of skilled men are particularly lacking: Draftsmen and letterers, photographers and blueprinters, blasters and powder men, skilled mechanics for auto repairs, steam and gas-engine runners, pipe calkers and lead-furnace men, masons and concrete workers, experienced well drillers, machinists, pipe fitters, mappers and surveyors, electricians, riggers and laboratory assistants.

Anyone able to assist in procuring men should communicate with Col. E. J. Dent, Camp Dix, N. J.

PERSONAL NOTES

A. F. STOTLER, supervisor of bridges and buildings, Northern Pacific Ry., has been appointed division engineer of the line west of Ellensburg, Wash., vice B. L. CROSBY, who has been granted an indefinite leave of absence on account of illness. Mr. Stotler's headquarters will be at Tacoma, Washington.

L. L. ADAMS, formerly assistant engineer, Louisville & Nashville R.R., has been commissioned first lieutenant in the Engineer Officers' Reserve Corps, being succeeded by G. C. WENDING. W. E. BAKER has been appointed assistant engineer, with headquarters at Jackson, Ky. succeeding F. M. CATES, resigned. G. R. SMILEY has been appointed assistant engineer, with headquarters at Louisville, Ky., succeeding L. L. MORTON, who has received a commission as captain in the Engineer Officers' Reserve Corps.

ROBERT H. BROWN has resigned as lecturer in sanitary engineering at Columbia University, to accept a commission as captain in the Sanitary Corps, United States National Army.

J. F. MANGOLD, for the past five years assistant professor of engineering at Grinnell College, and city engineer of Grinnell, Iowa, has been appointed professor of civil engineering in the South Dakota State School of Mines, Rapid City, South Dakota.

R. Z. KIRKPATRICK, formerly draftsman and checker on power plants and fuel-oil systems, Bureau of Yards and Docks, Navy Department, Washington, D. C., has been made chief hydrographer, Panama Canal, with headquarters at Balboa Heights.

C. W. E. CLARKE, of Stone & Webster, Boston, has been detailed to France on Government work in connection with the prosecution of the war.

ALEXANDER M. PARKER, who has been connected with the Pennsylvania R.R. in various engineering positions since 1888, has been appointed superintendent of the Camden Terminal Division of the West Jersey & Seashore R.R., with headquarters at Camden, New Jersey.

ANDREW J. WHITNEY has been appointed general superintendent of the northern division of the Pennsylvania R.R., with headquarters at Buffalo, New York.

CAPT. W. J. COWELL, Engineer Officers' Reserve Corps, for the past seven years assistant city engineer of Dallas, Tex., has been ordered to active duty at the Engineer Officers' Training School, Fort Leavenworth, Kansas.

W. K. ADAMS was graduated from the Engineer Officers' Training Camp Aug. 15, and has been commissioned as captain in the Engineer Officers' Reserve Corps. He has been assigned to duty with the 21st Railway Regiment at Rockford, Illinois.

MAX J. WELCH has returned from Peru, S. A., and has accepted the position of chief draftsman during the construction of the Traylor shipbuilding plant at Cornwells, Pennsylvania.

N. S. MULLICAN, city manager of the City of Thomasville, N. C., has resigned the position to accept that of chief highway engineer of Davidson County, North Carolina. Mr. Mullican has been retained by the City of Thomasville as consulting engineer.

H. E. HOLLISTER has resigned as chief engineer of the Kalbperry Corporation and of the Kalbfleisch Corporation to devote his time to the perfection of a new process for the conversion of nitercake into saltcake and sulphuric acid.

J. R. WATKINS has resigned as engineer-draftsman in the chief engineer's office of the Chesapeake & Ohio Ry. to accept a research fellowship in theoretical and applied mechanics at the University of Illinois.

S. J. STONE is at present in charge of the erection of a plant at Garden City, N. Y., for the Curtis Engineering Co. Mr. Stone is representative of the John W. Cowper Co., engineers and contractors, Buffalo, New York.

P. B. JEFFRIES, for the past seven years assistant engineer in the Vicksburg, Miss., office of the Alabama & Vicksburg and Vicksburg, Shreveport & Pacific Ry., has been promoted to the position of assistant engineer in the office of the assistant to the president of the above-named road, with headquarters in New Orleans.

SYDNEY D. KENDALL will leave shortly for France in connection with certain contracts for rebuilding those parts of France, Belgium and Russia which have been destroyed by the war.

CHARLES E. HEWETT, irrigation engineer, of North Yakima, Wash., has been engaged by the farmers' committee in charge of the irrigation project which contemplates the irrigation of Ford Prairie and Waunch's Prairie at Centralia, Washington.

N. G. JACOBSON, of the Portland, Ore., Forestry Service Office, has been appointed supervisor of the Des Chutes National Forest, to replace W. G. HASTINGS, who has taken charge of the Vermont State forests.

E. I. CORNELL, E. C. CORNELL, EDWARD SIMPSON and A. S. ALBERTSON, of Tacoma, Wash., have formed the Construction Company of Tacoma. They were associated in the construction of the cantonment buildings at Camp Lewis, American Lake.

MORELL & NICHOLS have been retained by the City Council of Great Falls, Mont., to make plans for the city development expected in the next 30 years.

L. R. WALKER, formerly designing engineer on concrete structures and assistant city engineer of Tucson, Ariz., has been transferred by the Trussed Concrete Steel Co. from its El Paso, Tex., office to its Youngstown, Ohio, office.

R. G. CARRAWAY has been commissioned first lieutenant in the Engineer Officers' Reserve Corps. He has been ordered to report for active service at Fort Leavenworth.

ELISHA LEE has been assigned to the duties previously administrated by W. W. ATTERBURY as vice president of the Pennsylvania Railroad Co. Mr. Atterbury's commission as brigadier general was predicted in our columns Oct. 18. Mr. Lee has been in the service of the Pennsylvania Railroad Co. since 1892, and was chairman of the Eastern Railroads' Conference Committee from 1912 to 1914, having in charge the negotiations with labor organizations. In May, 1916, in connection with the enlargement of the organization of the operating department of the lines east of Pittsburgh, Mr. Lee was promoted to the newly created office of assistant general manager, and on Apr. 1, 1917, he was made general manager.

OBITUARY

DR. E. F. ROEBER, editor of *Metallurgical and Chemical Engineering*, died at his residence in East Orange, N. J., Wednesday, Oct. 17, after an illness of several months. Dr. Roeber was widely known in the electrical-chemical industry of the United States, having been one of the founders of the Electro-Chemical Society in 1902, a member of its Board of Directors from 1902 to 1913, and president in 1913 and 1914. He also wielded a large influence in this field as editor and founder of *Electro-Chemical Industry* in 1902, and of its successor, *Metallurgical and Chemical Engineering*. Born in Torgau, Germany, Oct. 7, 1867, he was educated at the University of Jena, Halle, and Berlin, receiving the degree of Doctor of Philosophy from the latter institution in 1892. He came to the United States in 1894, and became associated with Dr. Carl Hering in Philadelphia in electrical engineering work.

BUSINESS NEWS

Industrial Census Planned for France After the War

Commercial Attache Veditz at Paris reports:

Among the important measures proposed by the French Government in the preparation for industrial reorganization after the war is an industrial census, which it is proposed to make obli-

gatory and very detailed and comprehensive.

The details of the project are likely to be worked out by the newly created economic committee of the Government recently established by decree, and comprising Paul Domeur, minister without portfolio, the minister of commerce, the minister of agriculture, the minister of colonies, the minister of transport, the minister of munitions, and the minister of provisionment. The minister of commerce will take part in the deliberations of this committee whenever they affect his department.

The purpose of the industrial census is to determine the nature and number of industrial machines, the extent and character of industrial equipment and available supplies of industrial materials. There has, however, been considerable opposition to the proposed census, coming chiefly from chambers of commerce and manufacturers' associations. Objection is particularly raised to the obligatory feature of the project, on the ground that article 55 of the new income-tax law specifically authorizes the tax officials to make use of information obtained by any branch of the public service under existing laws.

Motor Truck Contracts for Heavy War Service Placed

The following statement is authorized by the automotive products section of the Council of National Defense:

All contracts for the new heavy-duty war truck will have been placed by Nov. 1, according to present plans of the Quartermaster Department. Axles, motors, transmission and steering gears have already been ordered for the first 10,000 class B trucks and the remaining contracts will be placed shortly.

The trucks are being purchased by the Quartermaster Department, which works coöperatively with the war industries board of the Council of National Defense. The director of the military truck production section arranges with all of the makers of each part for a specified date when they shall visit him at headquarters to discuss the form of contract and secure specifications and necessary information. The section in turn hands over all available data to Brig. Gen. Chauncey B. Baker, of the Quartermaster Corps, who places the actual contracts following submission of bids by the makers.

Commends Parts Makers' Patriotism

"The parts makers," according to Gen. Baker, "have been willing to sell the Government at the same terms on a single order as they secure from large companies purchasing on long-time contracts, and if the patriotism of the industry is to be judged by the attitude of the parts makers in this particular situation it would be 100 per cent."

It is to be expected that the first delivery of trucks will take place in January and that the 10,000 will be completed by the latter part of June. Following the completion of the contract distributions the military truck production section will turn its efforts chiefly toward actual truck production.

A Year's Work by Turner Company

The Turner Construction Co., of New York City, has had prepared an artist's drawing, made to scale from photographs or blueprints, showing the reinforced-concrete industrial buildings erected by its forces during 1916. In all, 70 buildings valued at about $9,000,000 constituted the year's work. There were used 360,000 bbl. of cement, 25,000,000 lb. of reinforcing steel and 8,615,000 ft., board measure, of lumber for forms and falsework. The maximum number of men employed at any one time was 4190 and on one building 450.

The speed record was made on building 27, for the Belleville Warehouse Corporation, of New Bedford, Mass. This structure in two sections each 500 x 100 ft. in place, and eight stories high, was completed in 80 working days.

PHOTOGRAPH OF ARTIST'S DRAWING, SHOWING THE SEVENTY REINFORCED-CONCRETE INDUSTRIAL BUILDINGS ERECTED BY THE TURNER CONSTRUCTION CO. LAST YEAR

Notes from

MAKERS OF PLANT AND EQUIPMENT

General Iron Works Co. is the new name which has been substituted for the Potthoff Construction Co. The change of name does not indicate any change in the active management of the business.

Davis-Bournonville Co., with general offices and factory at Jersey City, has taken over the plant and factory of the Davis Acetylene Co. at Elkhart, Ind. The Davis company has been dissolved and the manufacture of acetylene lighting generators and accessories discontinued. The plant will hereafter be operated under management from Jersey City for the manufacture of acetylene pressure generators for the oxy-acetylene process, and for special products. The Canadian factory at Niagara Falls, Ontario, which has been jointly occupied by the two companies, has also been taken over, and will be operated exclusively for the manufacture of oxy-acetylene apparatus for the Canadian trade. The Davis-Bournonville Co. has also purchased the H. G. Kotten Co. factory and grounds opposite its Jersey City property. The Kotten factory will be used for manufacturing electrolytic oxygen apparatus and accessories, releasing considerable space in the company's new factory building for increased output of oxy-acetylene welding and cutting apparatus.

E. P. Reichhelm & Co., Inc., dealers in metal workers' supplies, has purchased the six-story structure at 26 John St., New York City. A feature of the transaction was that a large part of the payment was made in Liberty Bonds. The American Gas Furnace Co. and the American Swiss File and Tool Co., for which the Reichhelm company is the selling agent, are located in this building.

Roberts Filter Manufacturing Co., of Darby, Penn., has been awarded the contract for the erection of a filter plant at Hog Island for the American International Shipbuilding Corporation in connection with the new shipyards where a large portion of the mercantile marine fleet will be built. This yard is one that has been authorized recently by the United States Shipping Board. The company also has completed a 3,000,000-gal. filter plant at Camp Meade, Admiral, Md., and is building an 8,000,000-gal. plant for the Newport News Water and Light Co., at Newport News, Virginia.

Walter A. Zelnicker Supply Co. has recently secured the services of W. H.

Bramman, who is acting as assistant to the president. Mr. Bramman was formerly with the American Carbon & Battery Co.

Ransome Concrete Machinery Co. held its annual meeting at the plant in Dunellen, N. J., and at the Queen City Hotel, Plainfield, N. J., Oct. 12 to 14.

Roughen Adjustable Paving Gauge Co., Fond du Lac, Wis., announces that the J. M. Kelly Contracting Co., of Camden, N. J., is averaging 580 sq.yd. of 7-in. reinforced-concrete road with 18 men working 7½ hours daily.

Nye Odorless Crematory Co., of Macon, Ga., has constructed garbage incinerator plants at the following army cantonments: Ayer, Mass., where a plant with a capactity of handling 15 tons of material daily has been built; Wrightstown, N. J., 15 tons; Louisville, Ky., 15 tons; Admiral, Md., 15 tons; Yaphank, N. Y., 25 tons; Petersburg, Va., 25 tons; Columbia, S. C., 25 tons; Atlanta, Ga., 25 tons; San Antonio, Tex., 50 tons. These incinerators, according to A. B. Felton, Jr., president of the Nye company, are to be used for burning material that has no salable value. Other waste matter, from which byproducts may be recovered, is being utilized as outlined in *Engineering News-Record*, Oct. 18, p. 731.

APPLIANCES AND MATERIALS

Sheaves in New Grab Buckets Easy To Change

A new grab-bucket of the type closed by a vertical set of falls and from which the sheaves and entire lower block may be removed without taking out the main shaft, is being put on the market by the Advance Engineering Co., Cleveland, Ohio. The bucket, known as the "Aden," is closed with eight parts of line and handled on a trip line of two parts. The upper part of the bucket, connecting the arms and supporting the lifting sheave and the upper closing block, is in three sections to make repairs easy and inexpensive.

IMPROVED DESIGN ADDS TO DIGGING POWER OF NEW BUCKET

The guide-block for the closing line may be set on either side of the upper block between any pair of plates in this block. This makes it possible to adjust the bucket, after a boom has become warped, so that the lines will still run true, or to adjust the bucket for a boom with sheaves in tandem.

When open as far as the construction of the bucket will permit, the lips must bite in several inches before the counterweight of the lower block can touch the ground. This feature is claimed to be an improvement over previous designs, in that the closing motion begins as soon as a strain is taken, instead of having to wait until the counterweight is lifted from the ground before any appreciable digging effect is produced. The lower closing block, instead of being secured to the main shaft of the bucket, which may readily become slightly bent and difficult to remove, is held by a transverse pin through the counterweight. The bolts at the sides of the lower block plates are but slightly above the center pin, so that the bucket has to be set on a very steep slope before the lines can cut the bushings on these bolts. The design makes use of 12-in. sheaves, insuring long life for the closing line.

The photograph shows a load of dry clay containing gravel dug from a sewer trench in Cleveland, where five men, who had been employed to loosen the material with picks, were found unnecessary after the "Aden" bucket was installed. Light and heavy buckets in the ½ and ¾-yd. sizes for handling dry materials and for difficult digging are made, while heavy 1-yd. and 1¼-yd. buckets are also manufactured, following the same design.

Clear Plugged Hole of Hollow Drill Steel

Even though it is realized that plugged steels wholly or in part prevent proper functioning of the drill, considerable carelessness is met with in the matter of keeping the hole in the drill steel properly open. As a result, drilling speed is retarded, water tubes are bent or broken and time is lost tinkering or, as often happens, the drilling gang is idle while someone makes a trip to the shop after another drill steel or water tube.

To relieve this condition a compact and simply constructed machine has been put on the market by the Ingersoll-Rand Co., known as the Leyner Shank and Bit Punch, which is used as an auxiliary of the Leyner sharpener. The drill steel is clamped by two jaws brought together by the movement of a pinion, and when in this position a specially heat-treated steel punching pin, which is attached to the piston of the punch-operating cylinder, is forced by pressure into the clogged hole. On the extreme reverse stroke air is exhausted against the heated pin, effectually cooling it. The maximum stroke of the punch is 6 in., and an adjustable stop for the drill steel is provided which regulates the distance which the pin will penetrate. The standard punching pin is ⅞ in. in diameter for a distance of 2 in. from the end, and ⅝ in. for the remainder.

CLAMPING AND PUNCHING OPERATIONS ARE INTERLOCKED

The operation is controlled by a single lever, a downward movement of which clamps the steel and a further side movement operates the punch. The operation is interlocking in a way which prevents the advancement of the punch until the steel is locked, and in like manner the punching device must be in neutral position before the clamp jaws can be opened.